GROUND-WATER CONDITIONS IN UTAH, SPRING OF 1993

by

D.M. Batty, D.V. Allen, and others

United States Geological Survey

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CONVERSION FACTORS

Multiply	by	To obtain
acre-foot	1233	cubic meter
foot	0.3048	meter
inch	25.4	millimeter
mile	1.609	kilometer

Chemical concentration is given only in metric units--milligrams per liter. For concentrations less than 7,000 milligrams per liter, the numerical value is about the same as for concentrations in parts per million.

DEFINITIONS OF TERMS

Acre-foot (AC-FT, acre-ft)—The quantity of water required to cover one acre to a depth of one foot; equal to 43,560 cubic feet or about 326,000 gallons or 1,233 cubic meters.

Aquifer—A geologic formation, group of formations, or part of a formation that contains sufficient saturated permeable material to yield significant quantities of water to wells and springs.

Artesian—Describes a well in which the water level stands above the top of the aquifer tapped by the well (confined). A flowing artesian well is one in which the water level is above the land surface.

Dissolved—Material in a representative water sample that passes through a 0.45–micrometer membrane filter. This is a convenient operational definition used by Federal agencies that collect water data. Determinations of "dissolved" constituents are made on subsamples of the filtrate.

Land-surface datum (lsd)—A datum plane that is approximately at land surface at each ground-water observation well.

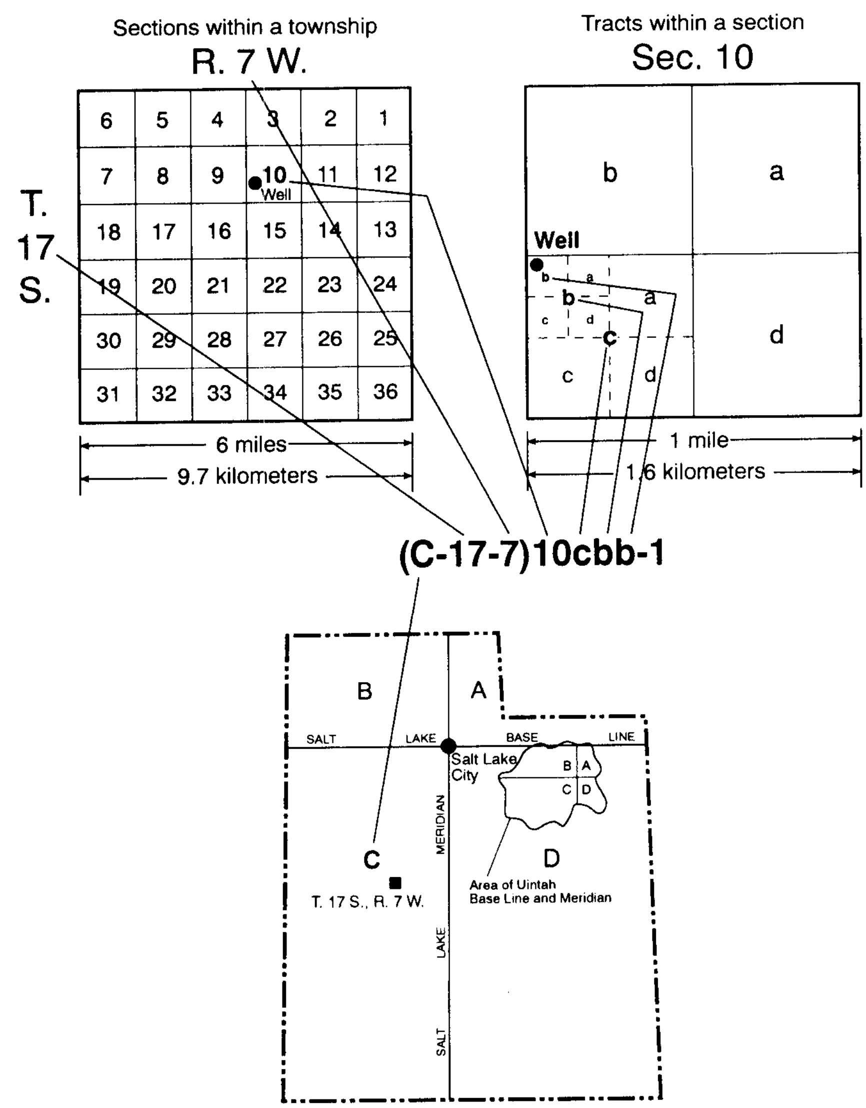
Milligrams per liter (MG/L, mg/L)—A unit for expressing the concentration of chemical constituents in solution. Milligrams per liter represents the mass of solute per unit volume (liter) of water.

Specific conductance—A measure of the ability of water to conduct an electrical current. It is expressed in microsiemens per centimeter at 25° Celsius. Specific conductance is related to the type and concentration of ions in solution and can be used for approximating the dissolved-solids content of the water. Commonly, the concentration of dissolved solids (in milligrams per liter) is about 65 percent of the specific conductance (in microsiemens). This relation is not constant in water from one well or stream to another, and it may vary for the same source with changes in the composition of the water.

Cumulative departure from average annual precipitation—A graph of the departure or difference between the average annual precipitation and the value of precipitation for each year, plotted cumulatively. A cumulative plot is generated by adding the departure from average precipitation for the current year to the sum of departure values for all previous years in the period of record. A positive departure, or above-average precipitation, for a year results in a graph segment trending upward; a negative departure results in a graph segment trending downward. A generally downward graph for a period of years represents a period of generally below-average precipitation, which commonly causes and correlates with declining water levels in wells. Likewise, a generally upward graph for a period of years represents a period of above-average precipitation, which commonly causes and correlates with rising water levels in wells. However, increases or decreases in withdrawals of ground water from wells also affect water levels and can change or eliminate the correlation between water levels in wells and the graph of cumulative departure from average precipitation.

WELL-NUMBERING SYSTEM

The well-numbering system used in Utah is based on the U.S. Bureau of Land Management's system of land subdivision. The well-numbering system is familiar to most water users in Utah, and the well number shows the location of the well by quadrant, township, range, section, and position within the section. Well numbers for most of the state are derived from the Salt Lake Base Line and the Salt Lake Meridian. Well numbers for wells located inside the area of the Uintah Base Line and Meridian are designated in the same manner as those based on the Salt Lake Base Line and Meridian, with the addition of the "U" preceding the parentheses. The numbering system is illustrated below.



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INTRODUCTION

This is the thirtieth in a series of annual reports that describe ground-water conditions in Utah. Reports in the series, published cooperatively by the U.S. Geological Survey and the Utah Division of Water Resources, provide data to enable interested parties to keep abreast of changing ground-water conditions.

This report, like the others in the series, contains information on well construction, ground-water withdrawals from wells, water-level changes, related changes in precipitation and streamflow, and chemical quality of water. Supplementary data such as maps showing water-level contours are included in reports of this series only for those years or areas for which applicable data are available and are important to a discussion of changing ground-water conditions.

The report includes individual discussions of selected major areas of ground-water development in the State for the calendar year 1992. Water-level fluctuations and selected related data, however, are described from the spring of 1988 to the spring of 1993 and also from the spring of 1963 to the spring of 1993. Much of the data used in the report were collected by the U.S. Geological Survey in cooperation with the Divisions of Water Rights and Water Resources, Utah Department of Natural Resources.

The following reports dealing with ground water in the State were printed by the U.S. Geological Survey, printed by cooperating agencies, or published in conference proceedings during 1992:

Review of water demand and water utilization studies for the Provo River drainage basin, and review of a study of the effects of the proposed Jordanelle Reservoir on seepage to underground mines, Bonneville Unit of the Central Utah Project, by K.M. Waddell, G.W. Freethey, D.D. Susong, and G.E. Pyper, U.S. Geological Survey Open-File Report 91-514.

Physical, chemical, and biological data for detailed study of irrigation drainage in the middle Green River basin, Utah, 1988-89, with selected data for 1982-87, by L.A. Peltz, U.S. Geological Survey, and Bruce Waddell, U.S. Fish and Wildlife Service, U.S. Geological Survey Open-File Report 91-530.

Ground-water conditions in Utah, spring of 1992, by D.M. Batty, L.R. Herbert, and others, Utah Division of Water Resources Cooperative Investigations Report No. 32.

Simulation of ground-water flow and water-level declines that could be caused by proposed withdrawals, Navajo Sandstone, southwestern Utah and northwestern Arizona, by V.M. Heilweil and G.W. Freethey, U.S. Geological Survey Water-Resources Investigations Report 90-4105.

Records of wells in sandstone and alluvial aquifers and chemical data for water from selected wells in the Navajo aquifer in the vicinity of the Greater Aneth Oil Field, San Juan County, Utah, by L.E. Spangler, U.S. Geological Survey Open-File Report 92-124 (duplicated as Utah Hydrologic-Data Report No. 47).

Selected hydrologic data for Cache Valley, Utah and Idaho, by D.M. Roark and K.M. Hanson, U.S. Geological Survey Open-File Report 92-173 (duplicated as Utah Hydrologic-Data Report No. 48).

Selected hydrologic data for Salt Lake Valley, Utah, 1990-92, with emphasis on data from the shallow unconfined aquifer and confining layers, by S.A. Thiros, U.S. Geological Survey Open-File Report No. 92-640 (duplicated as Utah Hydrologic-Data Report No. 49).

Seepage study of the Timpanogos, Wasatch, Sagebrush and Spring Creek, Upper Charleston, and Lower Charleston Canals, Wasatch County, Utah, by L.R. Herbert, C.B. Burden, and B.K. Thomas, Utah Department of Natural Resources Technical Publication No. 104.

Seepage study of the Bear River including Cutler Reservoir in Cache Valley, Utah and Idaho, by L.R. Herbert and B.K. Thomas, Utah Department of Natural Resources Technical Publication No. 105.

Hydrology of the Navajo aquifer in southwestern Utah and northwestern Arizona, including computer simulation of ground-water flow and water-level declines that could be caused by proposed withdrawals, by V.M. Heilweil and G.W. Freethey, *in* Harty, K.M., ed., Engineering and Environmental Geology of Southwestern Utah, Utah Geological Association Publication 21.

Physical extent, thickness, and quality of water of the principal aquifers, western Kane County, Utah, by L.E. Spangler, *in* Harty, K.M., ed., Engineering and Environmental Geology of Southwestern Utah, Utah Geological Association Publication 21.

Detailed study of selenium and selected elements in water, bottom sediment, and biota associated with irrigation drainage in the middle Green River basin, Utah, 1988-90, by D.W. Stephens, Bruce Waddell, L.A. Peltz, and J.B. Miller, U.S. Geological Survey Water-Resources Investigations Report 92-4084.

UTAH'S GROUND-WATER RESERVOIRS

Small quantities of ground water can be obtained from wells throughout much of Utah, but large supplies that are of suitable chemical quality for irrigation, public supply, or industrial use generally can be obtained only in specific areas. The major areas of ground-water development discussed in this report are shown in figure 1 and named in table 1. Relatively few wells outside of these areas yield large supplies of water of good chemical quality for the uses listed above, although some of the basins in western Utah and many areas in eastern Utah have not been explored sufficiently to determine their potential for ground-water development.

About 2 percent of the wells in Utah obtain water from consolidated rocks. The consolidated rocks that yield the most water are lava flows, such as basalt, which contain interconnected vesicular openings, fractures, or permeable weathered zones at the tops of flows; limestone, which contains fractures or other openings enlarged by solution; and sandstone, which contains open fractures. Most of the wells that penetrate consolidated rocks are in the eastern and southern parts of the State in areas where water supplies cannot be obtained readily from unconsolidated deposits.

About 98 percent of the wells in Utah withdraw water from unconsolidated deposits. These deposits may consist of boulders, gravel, sand, silt, or clay, or a mixture of some or all of these materials. Wells obtain the largest yields from the coarser materials that are sorted into deposits of uniform grain size. Most wells that tap unconsolidated deposits are in large intermountain basins, which have been partly filled with rock material eroded from the adjacent mountains.

SUMMARY OF CONDITIONS

The estimated total withdrawal of water from wells in Utah during 1992 was about 928,000 acre-feet (table 2), which is about 29,000 acre-feet more than the revised estimate for 1991 and about 153,000 acre-feet more than the average annual withdrawal for 1982-91 (table 3). The average annual withdrawal during 1988-92, 898,000 acre-feet, was 215,000 acre-feet more than during the preceding five-year period, 1983-87 (table 2). The estimated withdrawal of 928,000 acre-feet during 1992 is the second largest annual withdrawal of ground water on record since estimating statewide withdrawals began in 1963, exceeded only by the estimated 940,000 acre-feet withdrawn in 1990.

Withdrawals in 1992 for irrigation and public supply increased, compared with 1991 totals, but withdrawals for industry and domestic and stock use decreased. Withdrawals for irrigation were about 568,000 acre-feet (table 2), an increase of 26,000 acre-feet from 1991. Withdrawals for public supply were about 223,000 acre-feet, which is 27,000 acre-feet more than the estimate for 1991. Withdrawals for industrial use were about 75,000 acre-feet, which is 24,000 acre-feet less than the revised 1991 estimate, and the 62,000 acre-feet withdrawn in 1992 for domestic and stock use is 2,000 acre-feet less than the quantity for 1991.

In 8 of the 16 major areas of ground-water development referred to in this report (table 2), ground-water withdrawals increased from 1991 to 1992. These areas include Curlew, Cache, Salt Lake, Utah and Goshen, Juab, central Sevier, and Pahvant Valleys and "other areas." Withdrawals in Tooele Valley and Cedar Valley, Iron County, remained the same in 1992 as in 1991. Withdrawals in 1992 in the East Shore area, Sevier Desert, Parowan Valley, Milford, Beryl-Enterprise, and central Virgin River areas, were less than the estimated withdrawals for 1991.

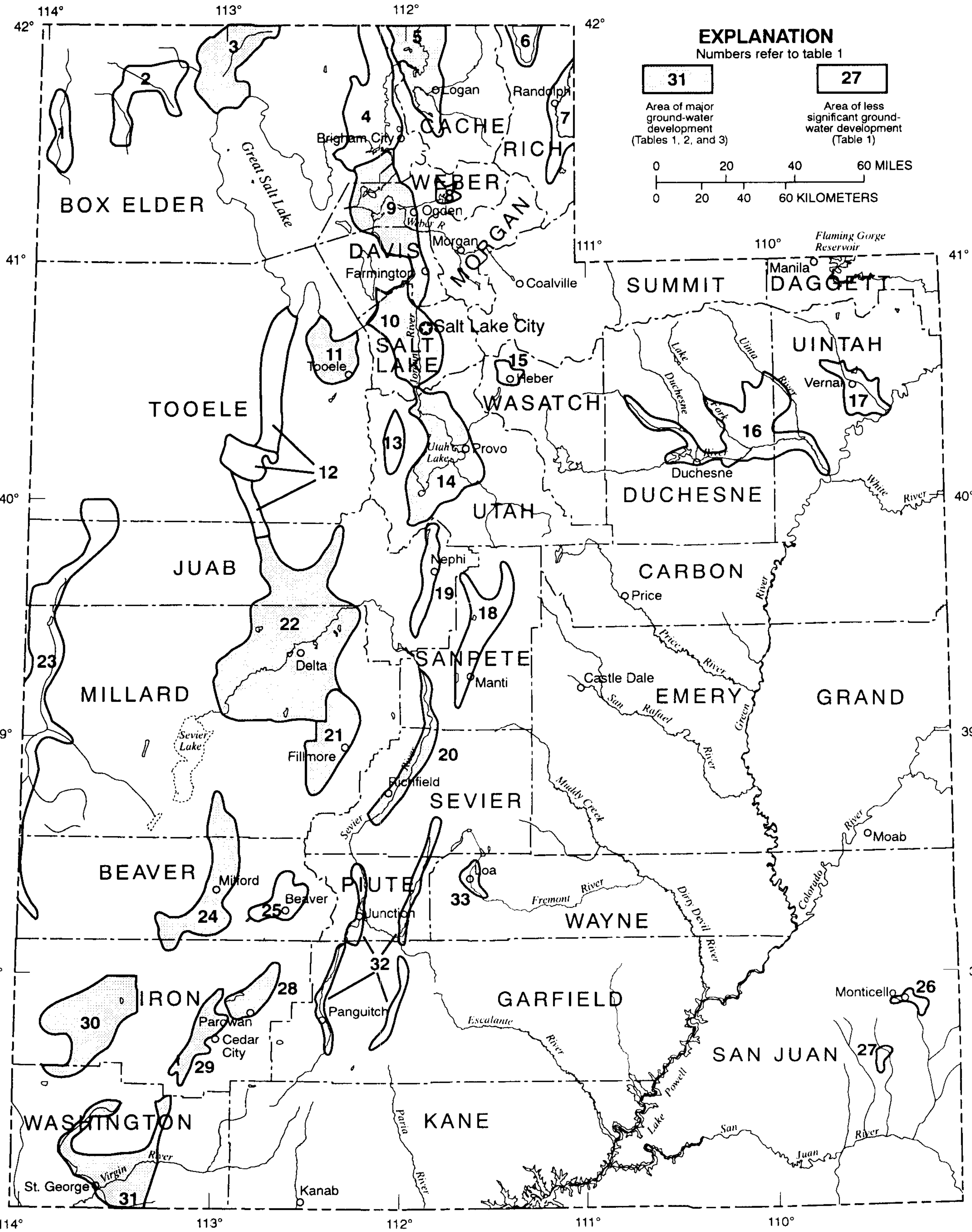

Figure 1. Areas of ground-water development specifically referred to in this report.

Table 1.—Areas of ground-water development in Utah specifically referred to in this report

Number in figure 1	Area	Principal type of water-bearing rocks
1	Grouse Creek Valley	Unconsolidated.
2	Park Valley	Do.
3	Curlew Valley	Unconsolidated and consolidated.
4	Malad-lower Bear River valley	Unconsolidated.
5	Cache Valley	Do.
6	Bear Lake valley	Do.
7	Upper Bear River valley	Do.
8	Ogden Valley	Do.
9	East Shore area	Do.
10	Salt Lake Valley	Do.
11	Tooele Valley	Do.
12	Dugway area	Do.
	Skull Valley	Do.
	Old River Bed	Do.
13	Cedar Valley, Utah County	Do.
14	Utah and Goshen Valleys	Do.
15	Heber Valley	Do.
16	Duchesne River area	Unconsolidated and consolidated.
17	Vernal area	Do.
18	Sanpete Valley	Do.
19	Juab Valley	Unconsolidated.
20	Central Sevier Valley	Do.
21	Pahvant Valley	Do.
22	Sevier Desert	Unconsolidated.
23	Snake Valley	Do.
24	Milford area	Do.
25	Beaver Valley	Do.
26	Monticello area	Consolidated.
27	Blanding area	Do.
28	Parowan Valley	Unconsolidated and consolidated.
29	Cedar Valley, Iron County	Unconsolidated.
30	Beryl-Enterprise area	Do.
31	Central Virgin River area	Unconsolidated and consolidated.
32	Upper Sevier Valleys	Unconsolidated.
33	Upper Fremont River Valley	Unconsolidated and consolidated.

Table 2.—*Number of wells constructed and withdrawal of water from wells in Utah*

Number of wells constructed in 1992—Data provided by Utah Department of Natural Resources, Division of Water Rights. Includes test wells and replacement wells.
Diameter of 12 inches or more—Constructed for irrigation, industry, or public supply.
Estimated withdrawals from wells—
1992 total: From Batty and others (1992, table 2), as revised.
1983-87 and 1988-92 average: Calculated from previous reports of this series and also include some previously unpublished revisions.

	Number in figure 1	Number of wells constructed in 1992		Estimated withdrawals from wells (acre-feet)							
				1992					1991	1983-87	1988-92
		Total	Diameter of 12 inches or more	Irrigation	Industry	Public supply	Domestic and stock	Total (rounded)	total (rounded)	average (rounded)	average (rounded)
Curlew Valley	3	1	0	44,000	0	50	50	44,000	37,000	24,000	37,000
Cache Valley	5	69	4	16,100	6,800	10,900	1,800	36,000	29,000	22,000	32,000
East Shore area	9	95	3	[1]24,800	7,300	22,200	5,000	59,000	68,000	58,000	64,000
Salt Lake Valley	10	215	5	4,000	[2]24,900	86,000	23,000	138,000	135,000	110,000	148,000
Tooele Valley	11	32	1	[1]24,200	1,400	4,500	300	30,000	30,000	22,000	29,000
Utah and Goshen Valleys	14	98	2	68,800	4,800	46,900	20,600	141,000	124,000	84,000	126,000
Juab Valley	19	2	0	28,100	0	[3]800	500	29,000	25,000	11,000	26,000
Sevier Desert	22	48	1	27,100	3,800	2,200	300	33,000	34,000	11,000	27,000
Central Sevier Valley	20	[4]15	0	15,100	100	1,800	2,200	19,000	18,000	17,000	18,000
Pahvant Valley	21	3	0	85,400	100	450	300	86,000	74,000	54,000	80,000
Cedar Valley, Iron County	29	16	2	29,300	250	4,600	300	34,000	34,000	21,000	29,000
Parowan Valley	28	6	3	[5]30,000	0	600	150	31,000	32,000	23,000	29,000
Escalante Valley											
Milford area	24	12	4	35,400	[6]5,600	850	250	42,000	54,000	42,000	46,000
Beryl-Enterprise area	30	23	4	69,600	600	550	750	72,000	79,000	94,000	82,000
Central Virgin River area	31	9	0	2,400	200	10,700	250	14,000	[7]15,000	19,000	[7]18,000
Other areas [8,9]		458	20	64,000	19,300	30,300	6,300	120,000	111,000	71,000	107,000
Totals (rounded)		[10]1,102	49	568,000	75,000	223,000	62,000	928,000	[7]899,000	683,000	[7]898,000

[1] Includes some domestic and stock use.
[2] Includes some use for air conditioning, about 30 percent of which is reinjected into the aquifer.
[3] Includes some industrial use.
[4] Includes wells constructed in upper Sevier Valley and upper Fremont River Valley.
[5] Includes some use for stock.
[6] Withdrawal for geothermal power generation. Approximately 5,500 acre-feet was reinjected.
[7] Revised.
[8] Withdrawals are estimated minimum. See page 91 for withdrawal estimates for other areas.
[9] Includes withdrawals for upper Sevier Valley and upper Fremont River Valley that were included with central Sevier Valley in previous reports of this series.
[10] Includes 592 wells drilled for new appropriations of ground water and 74 replacement wells. Data from Division of Water Rights, Utah Department of Natural Resources.

Table 3.—*Total annual withdrawal of water from wells in major areas of ground-water development in Utah, 1982-91*

[From previous reports of this series]

Area	Number in figure 1	Thousands of acre-feet										
		1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1982-91 average (rounded)
Curlew Valley	3	26	18	20	27	26	29	34	29	43	37	29
Cache Valley	5	26	20	21	22	23	26	33	30	32	29	26
East Shore area	9	38	43	49	67	66	67	68	61	65	68	59
Salt Lake Valley	10	115	110	102	110	104	122	165	157	143	135	126
Tooele Valley	11	26	22	23	22	21	22	26	27	33	30	25
Utah and Goshen Valleys	14	86	74	78	88	75	104	113	121	129	124	99
Juab Valley	19	16	6	6	11	10	22	22	28	27	25	17
Sevier Desert	22	16	8	10	13	11	15	15	17	34	34	17
Central Sevier Valley [1]	20	23	17	16	17	18	18	17	18	18	18	18
Pahvant Valley	21	70	42	42	62	60	66	71	82	88	74	66
Cedar Valley, Iron County	29	28	21	20	23	19	21	20	28	30	34	24
Parowan Valley	28	25	22	22	25	24	22	20	29	31	32	25
Escalante Valley												
Milford area	24	55	39	32	49	46	44	40	46	48	54	45
Beryl-Enterprise area	30	99	86	95	100	93	97	88	85	86	79	91
Central Virgin River area [2]	31	27	16	19	21	20	20	18	23	22	15	20
Other areas		105	56	68	81	72	79	95	100	111	111	88
Totals		781	600	623	738	688	774	[1]845	[1]881	[1]940	899	775

[1] Previously included upper Sevier and upper Fremont River valleys.
[2] Prior to 1984 included under 'Other Areas'.

Withdrawals during 1992 in 12 of the 16 areas exceeded the 1982-91 average annual withdrawals for each area. The average annual withdrawals during 1988-92 for 15 of the 16 areas also exceeded the average annual withdrawals for the preceding five-year period, 1983-87. The average annual withdrawal of 82,000 acre-feet in the Beryl-Enterprise area during 1988-92 is 12,000 acre-feet less than the average annual withdrawal for 1983-87.

The quantity of water withdrawn from wells is related to demand and availability of water from other sources, which in turn are related partly to local climatic conditions. Calendar year 1988 was the first year of generally less-than-average precipitation in Utah after six years of greater-than-average precipitation (National Oceanic and Atmospheric Administration, 1992-93). The trend of less-than-average precipitation has continued through 1992. Of the 32 weather stations throughout Utah for which average annual precipitation values and graphs of cumulative departure from the average annual precipitation are included in this report, 22 stations recorded precipitation in 1992 that was less than the long-term average annual value. The largest negative departure in 1992 from average precipitation was the 8.83 inches below the average recorded at Silver Lake, Brighton. The largest positive departure in 1992 from average precipitation was the 2.65 inches above the average recorded at Bluff.

Average annual precipitation during 1988-92 was lower than in the preceding five-year period, 1983-87, at all of the 32 weather stations included in this report—the average difference between the five-year periods for the 32 stations is 5.21 inches. This generally lower-than-average precipitation in the State during 1988-92 as compared with 1983-87 resulted in less recharge to the ground-water reservoirs. This, coupled with increased withdrawals for irrigation and public supply and continued large withdrawals for industry and domestic and stock use, resulted in declines in ground-water levels in most parts of almost all of the major areas of ground-water development in the State from the spring of 1988 to the spring of 1993.

No rises in water levels were observed from March 1988 to March 1993 in Juab and Parowan Valleys. Water levels rose in most of the central Virgin River area, and water levels also rose in parts of all the other major areas, possibly because of local decreases in withdrawals.

Water-level declines were observed from March 1963 to March 1993 in most parts of 11 of the 16 major areas referred to in this report (table 2). A net decrease in water levels was recorded in Parowan Valley for the period 1963-93. Water levels rose in parts of all the other major areas possibly because of local decreases in withdrawals, and water levels rose in most of Tooele, Pahvant, and central Sevier Valleys and in the central Virgin River area.

The total number of wells constructed during 1992, 1,102 (table 2), taken from reports by well drillers filed with the Utah Division of Water Rights, is 179 less than was reported for 1991 and 94 more than was reported in 1990. Of the 1,102 wells constructed in 1992, 592 were for new appropriations of ground water and 74 were replacement wells. The remaining 436 wells include test and monitoring wells. Forty-nine large-diameter wells (12 inches or more), mostly used for withdrawal of water for public supply, irrigation, and industrial use, were constructed in 1992.

The areas of ground-water development specifically referred to in this report are shown in table 1. Information about well construction and withdrawal of water from wells in Utah for four major use categories during 1992 is given in table 2. Total annual withdrawals from wells in the major areas of ground-water development in Utah for 1982-91 are shown in table 3.

MAJOR AREAS OF GROUND-WATER DEVELOPMENT

CURLEW VALLEY

by J.D. Sory

Withdrawal of water from wells in Curlew Valley in 1992 was approximately 44,000 acre-feet, an increase of 7,000 acre-feet from the quantity reported for 1991 and 15,000 acre-feet more than the average annual withdrawal for 1982-91 (tables 2 and 3). The 1992 value is the largest annual withdrawal on record. The average annual withdrawal for 1988-92, 37,000 acre-feet, was 13,000 acre-feet more than for the preceding five-year period, 1983-87. All of the increased withdrawals were for irrigation.

Water levels in Curlew Valley generally declined from March 1988 to March 1993, with the largest decline, 42.2 feet, measured in a well west of Snowville (fig. 2). The declines probably are the result of increased withdrawals for 1988-92 compared with the previous five-year period and possibly decreased recharge because of less precipitation during 1988-92. Precipitation at Snowville during 1992 was 11.12 inches, 1.35 inches less than in 1991, and 1.20 inches less than the average annual precipitation for 1941-92. The average annual precipitation during 1988-92, 10.43 inches, was 4.48 inches less than the average annual precipitation for the preceding five-year period, 1983-87, and 1.89 inches less than the 1941-92 average. Water levels rose slightly in a well in the western part of the valley and in a well east of Snowville. The rises may be the result of decreases in local ground-water withdrawals.

Water-level data were insufficient to prepare a contour map of water-level change from March 1963 to March 1993 (fig. 3). However, from 1963 to 1993, water levels in a well west of Snowville declined about 38 feet, and water levels in a well in the Kelton area declined about 5 feet as shown in the hydrographs in figure 4. These declines, and particularly the decline in the well west of Snowville, are the result of increased withdrawals of ground water. Prior to 1963, withdrawals were negligible; however, from 1963 through 1992, withdrawals increased to as much as 44,000 acre-feet per year.

The relation of water levels in two selected observation wells to cumulative departure from the average annual precipitation at Snowville, to annual withdrawals from wells, and to concentration of dissolved solids in water from well (B-15-9)28cbc-1, northwest of Snowville, is shown in figure 4. The hydrographs for wells (B-14-9)7bbb-1 in the irrigated area near Snowville and (B-12-11)16cdc-1 near the irrigated area of Kelton are representative of the ground-water levels in those areas, and show the effects of precipitation and the resulting recharge and withdrawals for irrigation.

The concentration of dissolved solids in water from well (B-15-9)28cbc-1 increased during 1974-90 from about 2,500 milligrams per liter to about 4,300 milligrams per liter. Two possible causes of this increase are movement of saline water toward the well because of water-level declines in the area and recharge from unconsumed irrigation water in which dissolved solids in the water have been concentrated by evaporation.

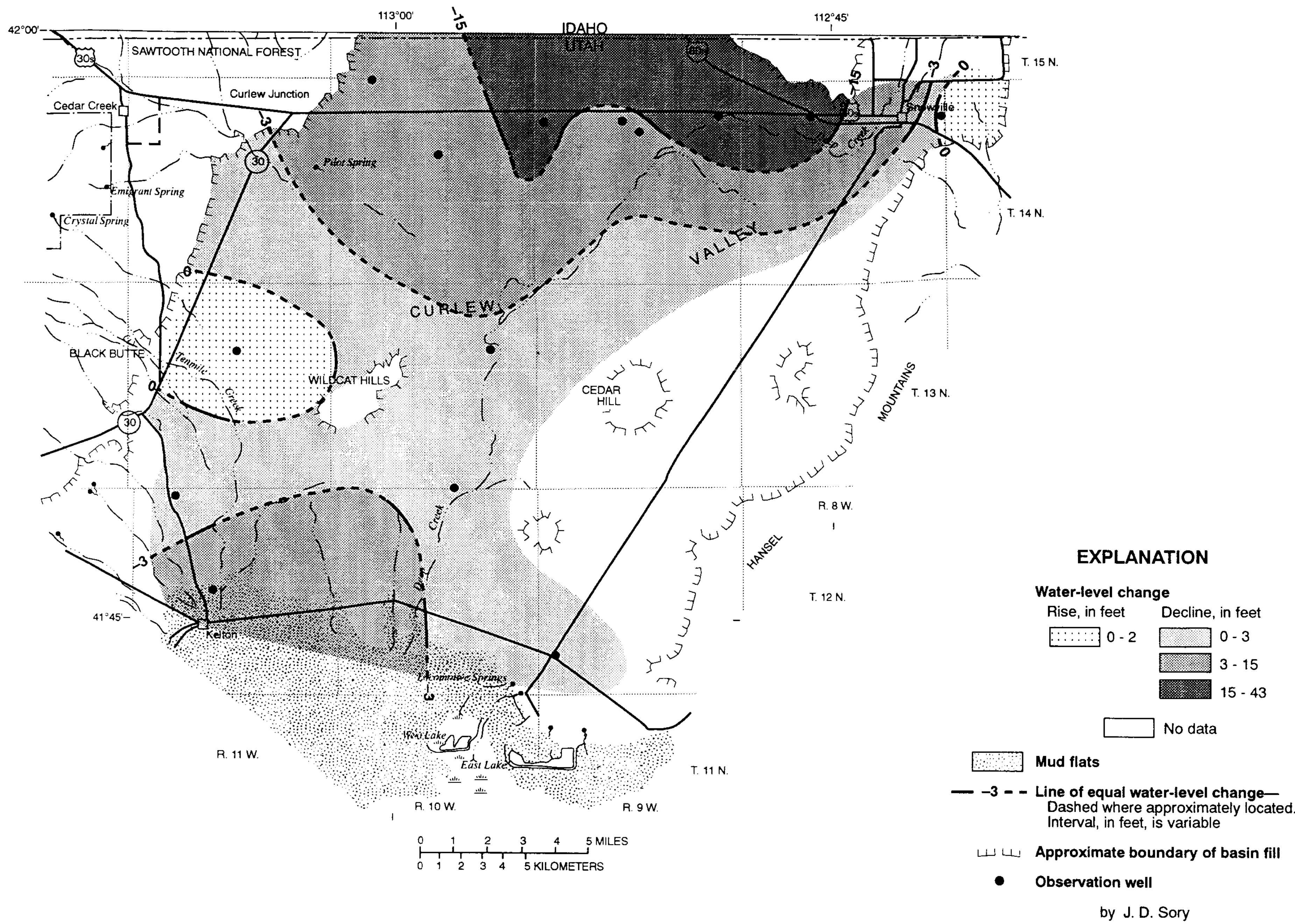

Figure 2. Map of Curlew Valley showing change of water levels from March 1988 to March 1993.

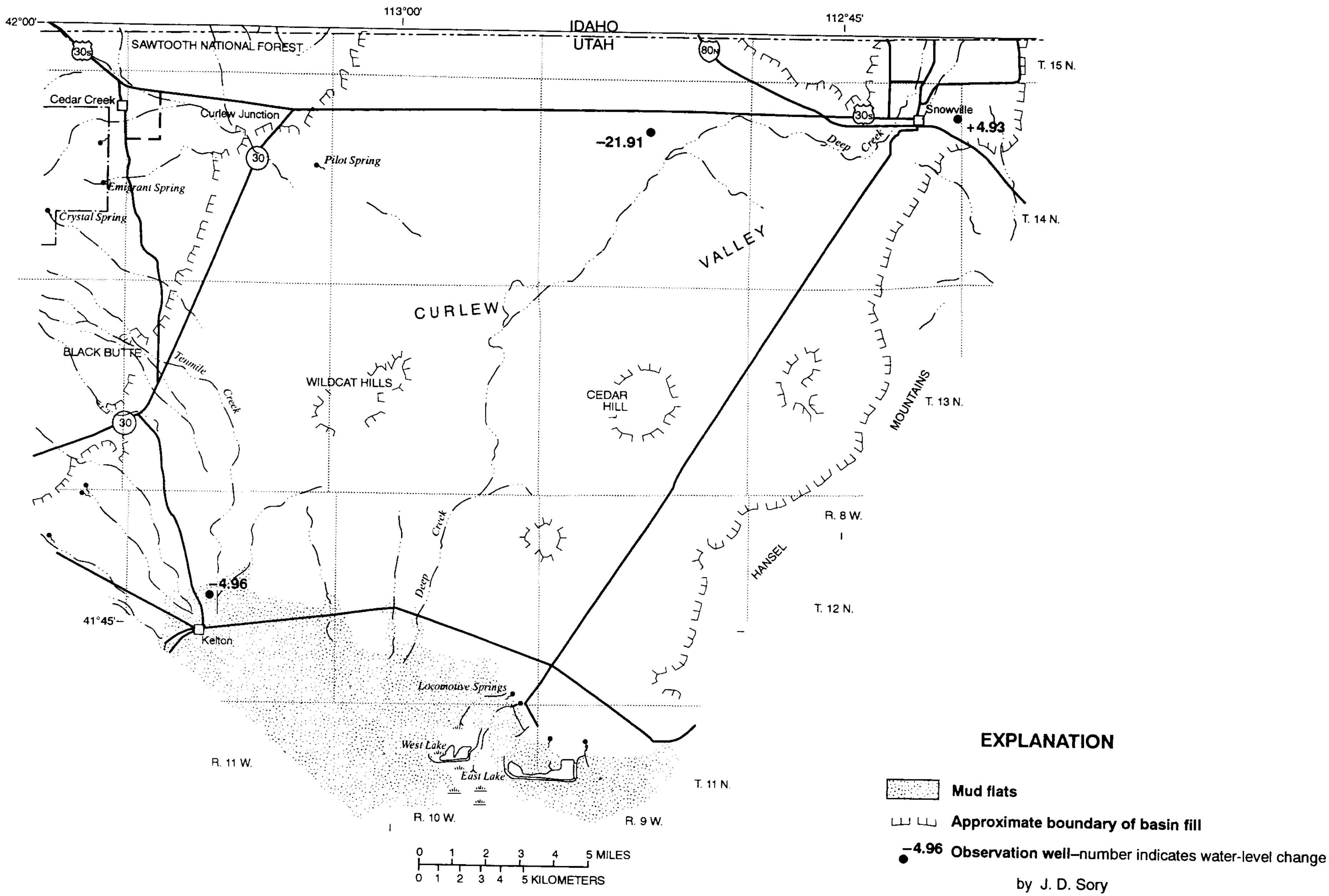

Figure 3. Map of Curlew Valley showing change of water levels from March 1963 to March 1993.

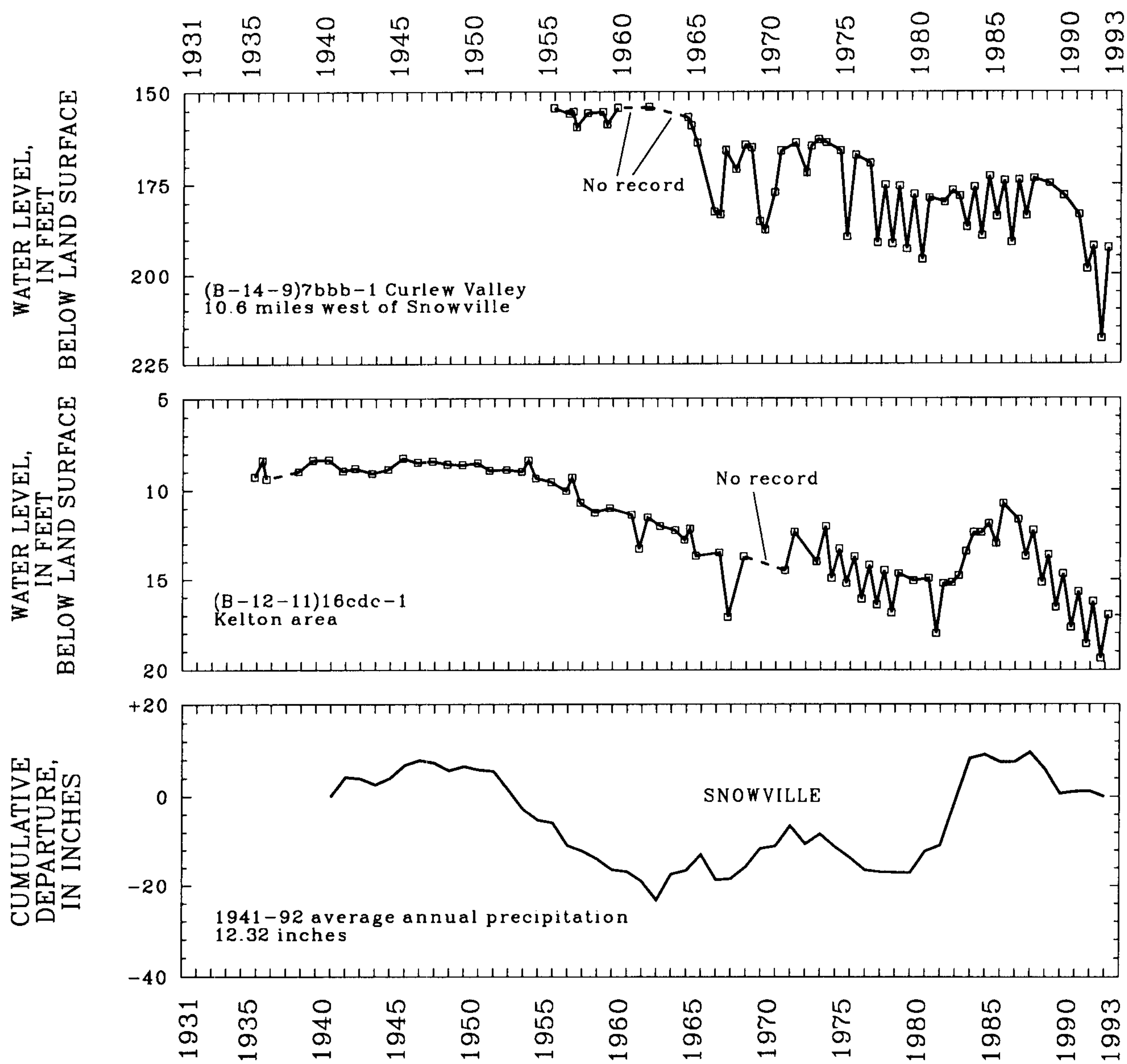

Figure 4. Relation of water levels in selected wells in Curlew Valley to cumulative departure from the average annual precipitation at Snowville, to annual withdrawals from wells, and to concentration of dissolved solids in water from well (B-15-9)28cbc-1.

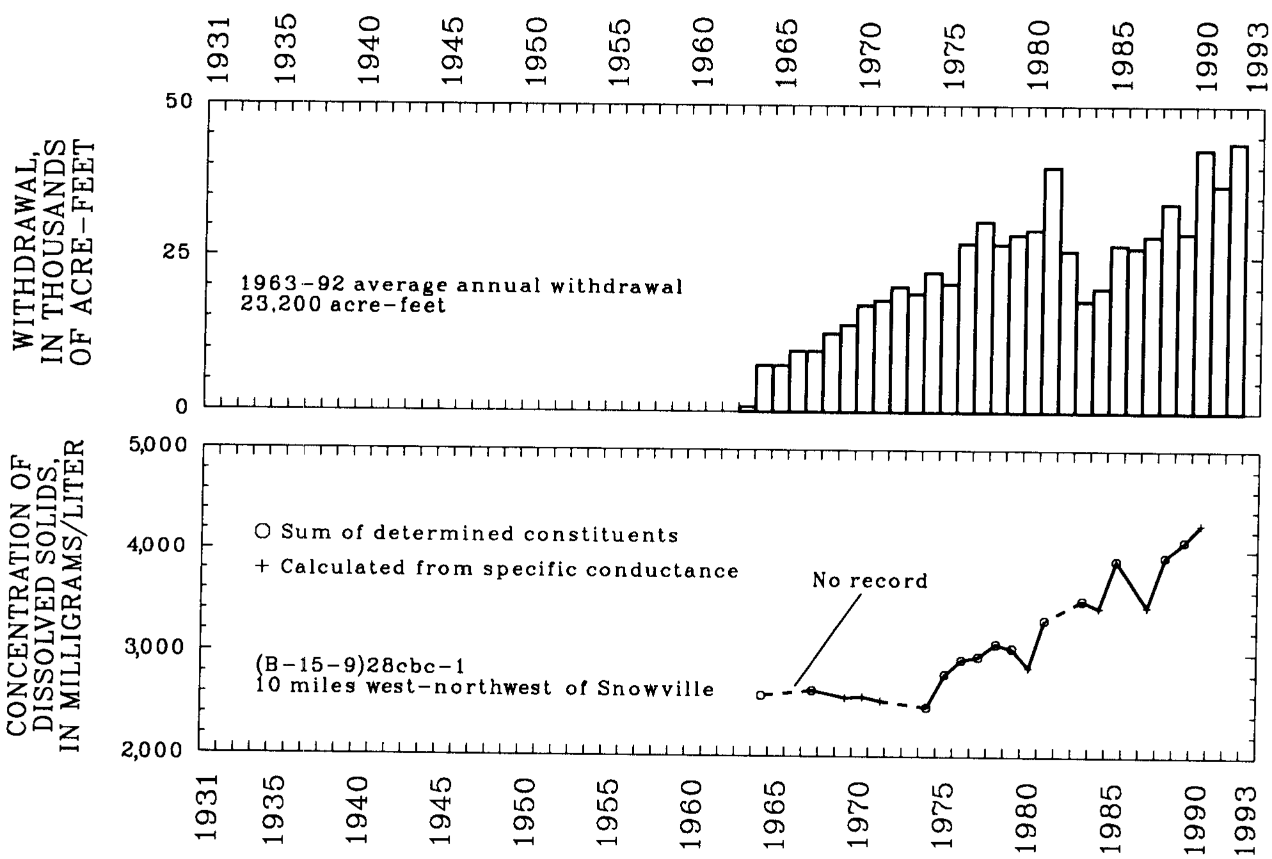

Figure 4. Relation of water levels in selected wells in Curlew Valley to cumulative departure from the average annual precipitation at Snowville, to annual withdrawals from wells, and to concentration of dissolved solids in water from well (B-15-9)28cbc-1—Continued.

CACHE VALLEY

by K.M. Hanson

Withdrawal of water from wells in Cache Valley in 1992 was approximately 36,000 acre-feet. This was 7,000 acre-feet more than was reported for 1991 and 10,000 acre-feet more than the average annual withdrawal for 1982-91 (tables 2 and 3). The average annual withdrawal for 1988-92 was 10,000 acre-feet more than during the preceding five-year period, 1983-87. The increase in withdrawals in 1992 was mostly because of increased withdrawals for public supply and irrigation. Withdrawal for public supply was 10,900 acre-feet, 2,300 acre-feet more than the value for 1991. Withdrawal for irrigation during 1992 was about 16,100 acre-feet, approximately 5,100 acre-feet more than the quantity for 1991.

Water levels declined from March 1988 to March 1993 in almost all of Cache Valley, with larger declines occurring near, and also north and south of Logan (fig. 5). The largest decline, 8.3 feet, was measured in a well about 2 miles south of Smithfield. The declines probably were the result of below-average precipitation in five of the previous six years, which resulted in a decrease in recharge and an increase in withdrawals during 1988-92 compared with the previous five-year period, 1983-87.

Water levels declined in most of the northern part of Cache Valley from March 1963 to March 1993 (fig. 6). Data were lacking to define water-levels changes in the southern part of the valley. The largest decline, about 9 feet, occurred about a mile west of Smithfield. The only increases, both less than a foot, occurred in the northwestern part of the valley south of Cache Junction and at Clarkston.

The relation of water levels in wells (A-12-1)29cab-1 and (A-13-1)29adc-1, to total discharge of the Logan River near Logan, to cumulative departure from the average annual precipitation at the Logan, Utah State University (USU) station, to annual withdrawals from wells, and to concentration of dissolved solids in water from well (A-11-1)8dda-3 are shown in figure 7.

Total discharge of the Logan River (combined flow from the Logan River above State Dam near Logan and Logan, Hyde Park, and Smithfield Canal at Head, near Logan) during 1992 was about 79,300 acre-feet, which is approximately 38,200 acre-feet less than the 117,500 acre-feet for 1991 and 44 percent of the 1941-92 average annual discharge.

Annual precipitation at the Logan USU station was 13.61 inches in 1992. This was 6.72 inches less than the quantity reported for 1991, and 4.96 inches less than the average annual precipitation for 1941-92. The average precipitation for 1988-92, 15.30 inches, was 9.34 inches less than the average of 24.64 inches for the preceding five years, 1983-87.

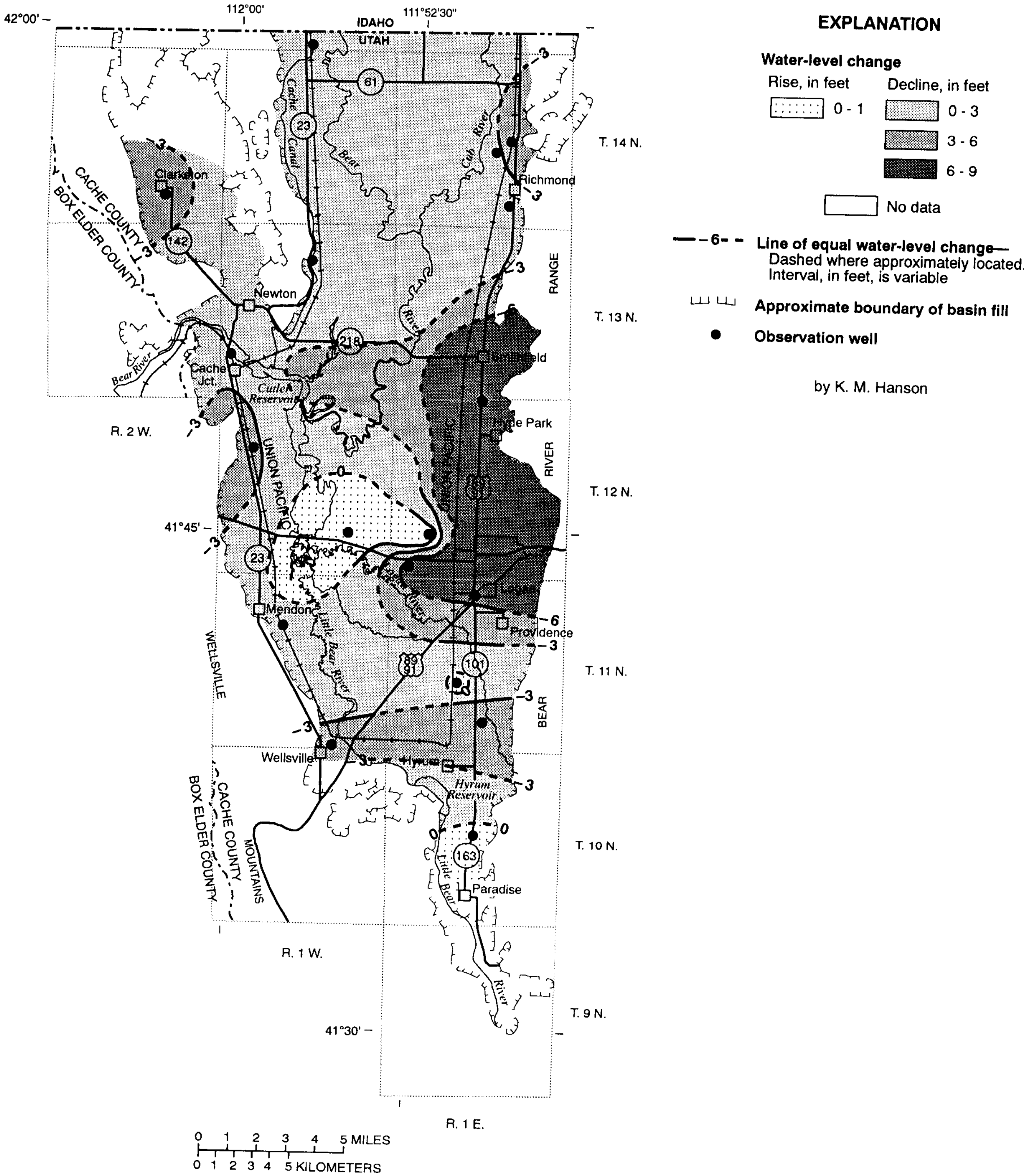

Figure 5. Map of Cache Valley showing change of water levels from March 1988 to March 1993.

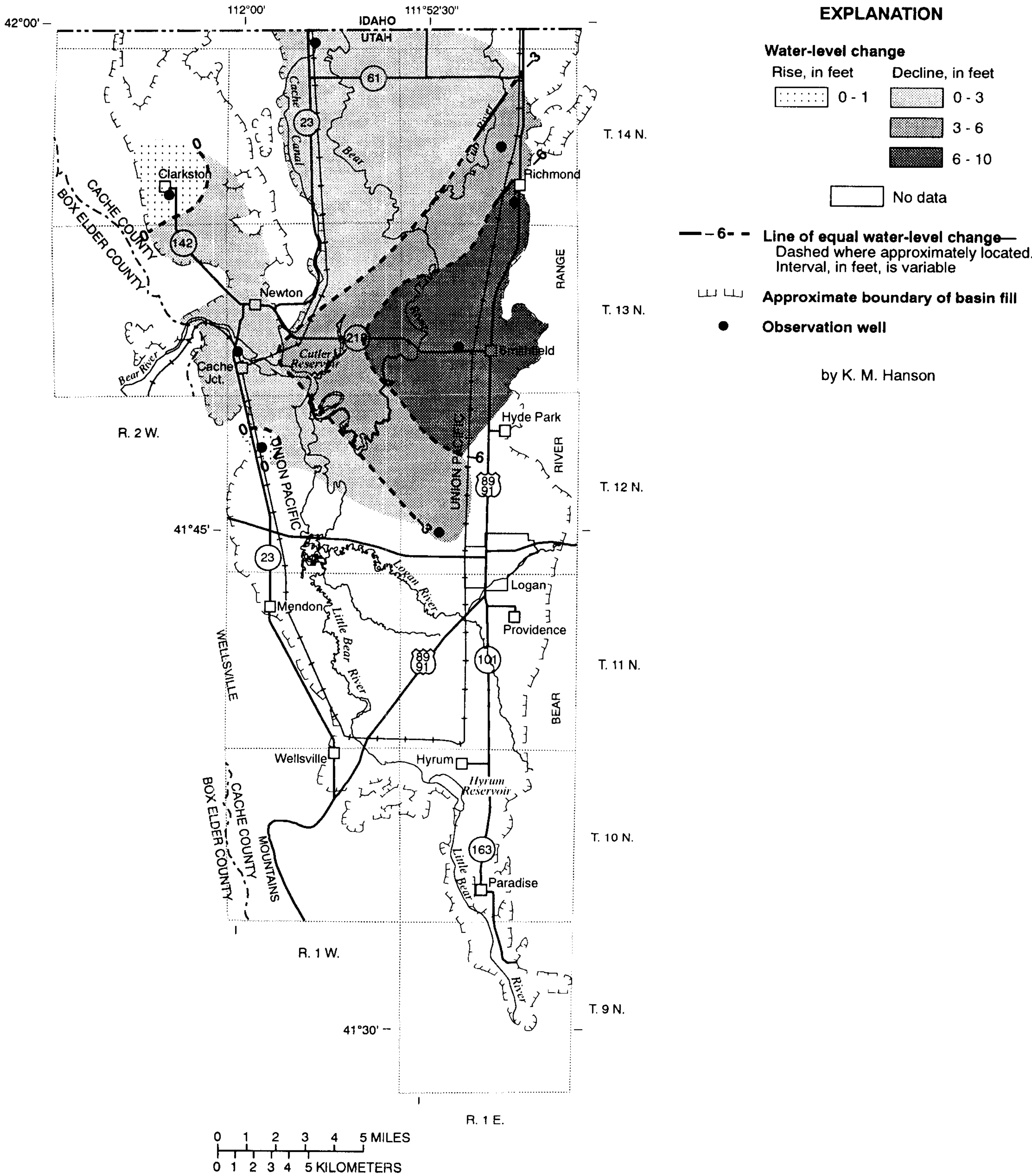

Figure 6. Map of Cache Valley showing change of water levels from March 1963 to March 1993.

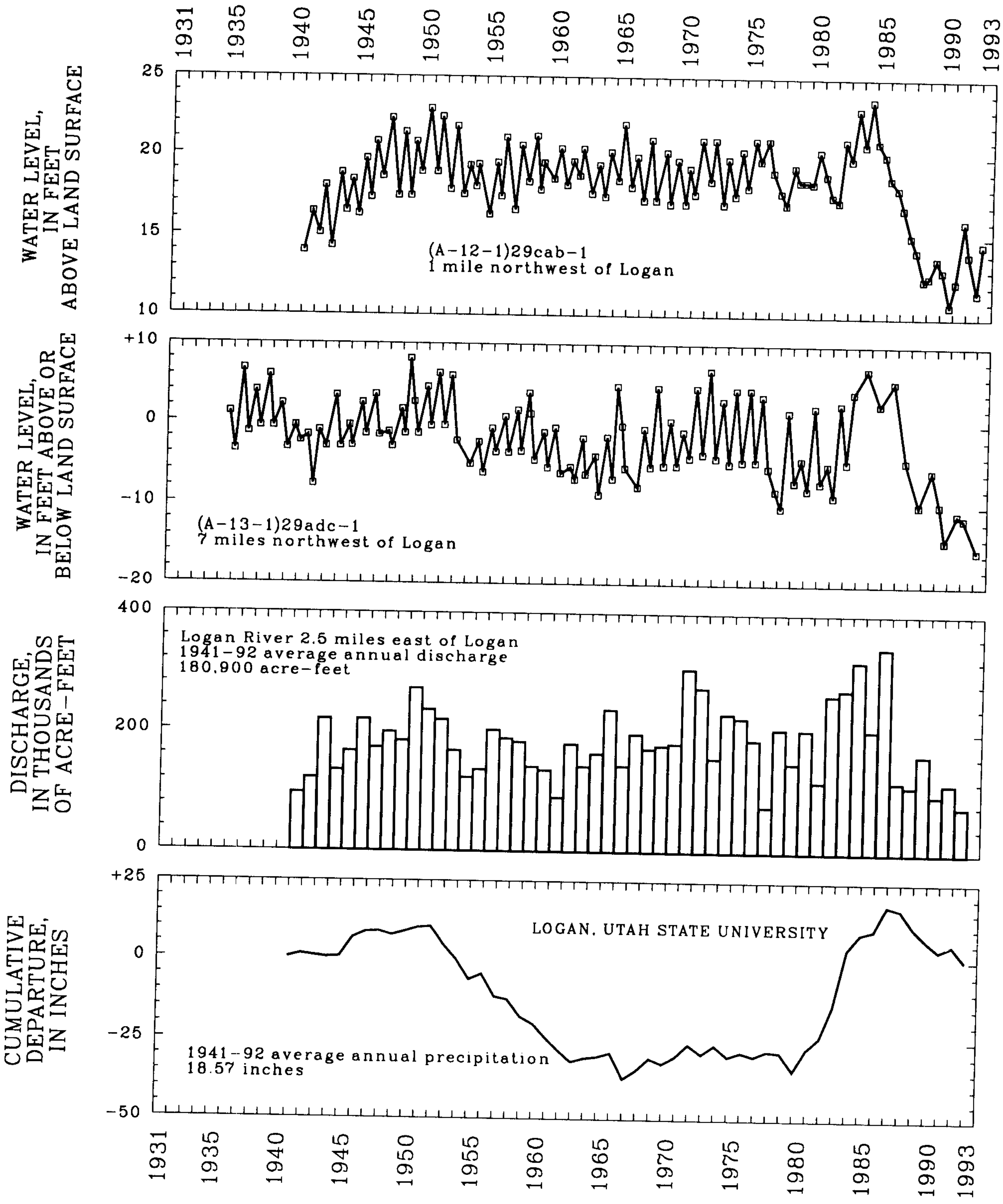

Figure 7. Relation of water levels in selected wells in Cache Valley to total discharge of the Logan River near Logan, to cumulative departure from the average annual precipitation at Logan, Utah State University, to annual withdrawals from wells, and to concentration of dissolved solids in water from well (A-11-1)8dda-3.

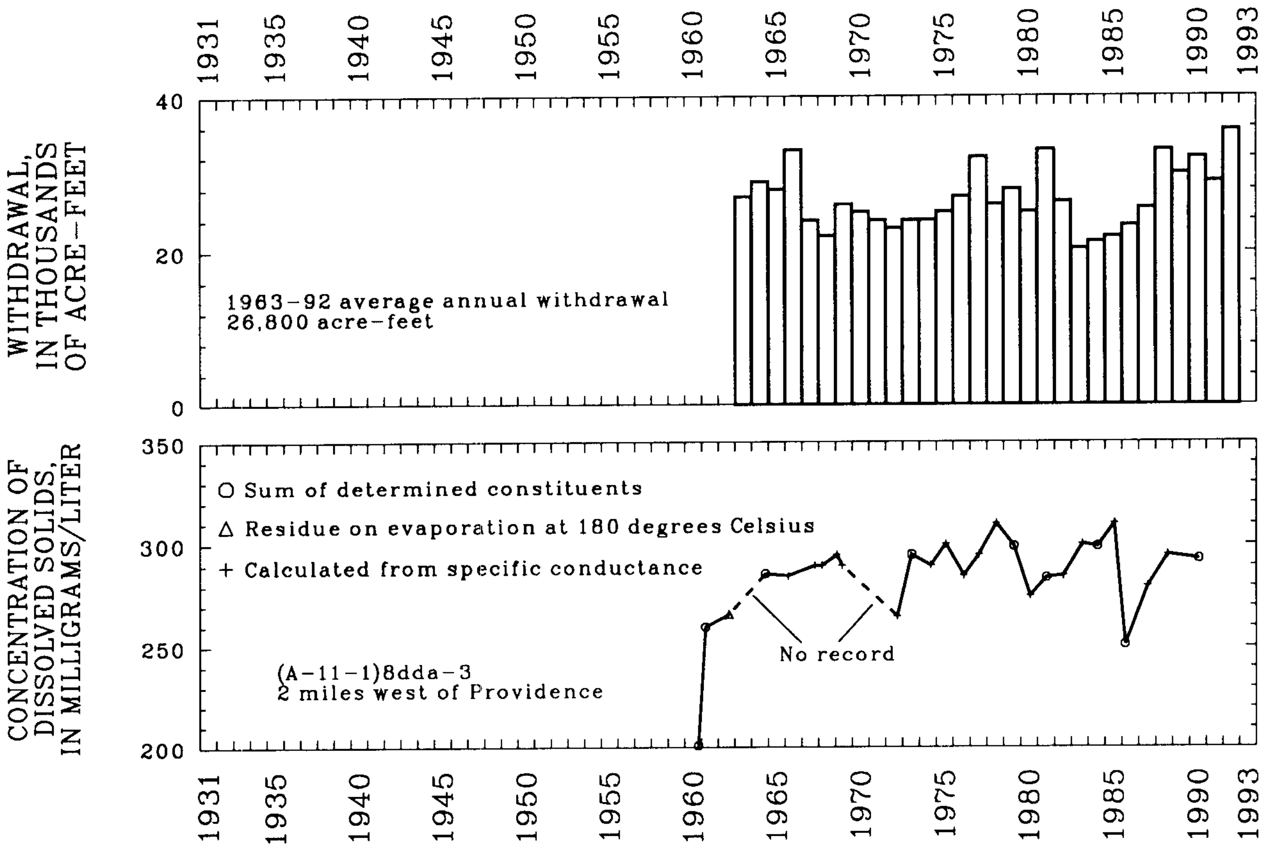

Figure 7. Relation of water levels in selected wells in Cache Valley to total discharge of the Logan River near Logan, to cumulative departure from the average annual precipitation at Logan, Utah State University, to annual withdrawals from wells, and to concentration of dissolved solids in water from well (A-11-1)8dda-3—Continued.

EAST SHORE AREA

by W.J. Thomas

Withdrawal of water from wells in the East Shore area in 1992 was approximately 59,000 acre-feet, 9,000 acre-feet less than was reported for 1991 and the same as the average annual withdrawal for 1982-91 (tables 2 and 3). The decrease in withdrawals from 1991 to 1992 occurred because Pineview Reservoir was nearly drained in order to repair Pineview Dam, which made more surface water available. Withdrawal for public supply was 22,200 acre-feet, 7,200 acre-feet less than in 1991. Industrial withdrawal decreased during 1992 by 1,200 acre-feet, to 7,300 acre-feet, and irrigation withdrawal decreased 200 acre-feet to 24,800 acre-feet. The average annual withdrawal for 1988-92, 64,000 acre-feet, was 6,000 acre-feet more than for the preceding five-year period, 1983-87.

Water levels generally declined from March 1988 to March 1993 in most of the East Shore area. The largest declines, from about 17 to 20 feet, were measured in wells in Ogden, southwest of Farmington, and southwest of Syracuse (fig. 8). The decline in water levels probably is the result of increased withdrawals during 1988-92, compared with the preceding five-year period, 1983-87, and decreased recharge resulting from less precipitation during 1988-92, as compared with the preceding five-year period, 1983-87. Rises in water levels of less than 7 feet occurred in local areas along the western edge of the East Shore area and near North Ogden.

Water levels generally declined from March 1963 to March 1993 in the East Shore area (fig. 9); the maximum decline of 43.0 feet was measured in a well southwest of Syracuse. The declines are the result of continued large withdrawals since 1985. Water levels rose less than 9 feet in a small area near Woods Cross.

The relation of water levels in selected observation wells to cumulative departure from the average annual precipitation at the Ogden Pioneer Powerhouse, to annual withdrawals from wells, and to concentration of dissolved solids in water from well (B-4-2)27aba-1 is shown in figure 10. Precipitation at the Ogden Pioneer Powerhouse in 1992 was 19.08 inches, 2.46 inches less than the average annual precipitation for 1937-92. The average annual precipitation for 1988-92, 19.67 inches, was 6.37 inches less than the average for the preceding five-year period, 1983-87.

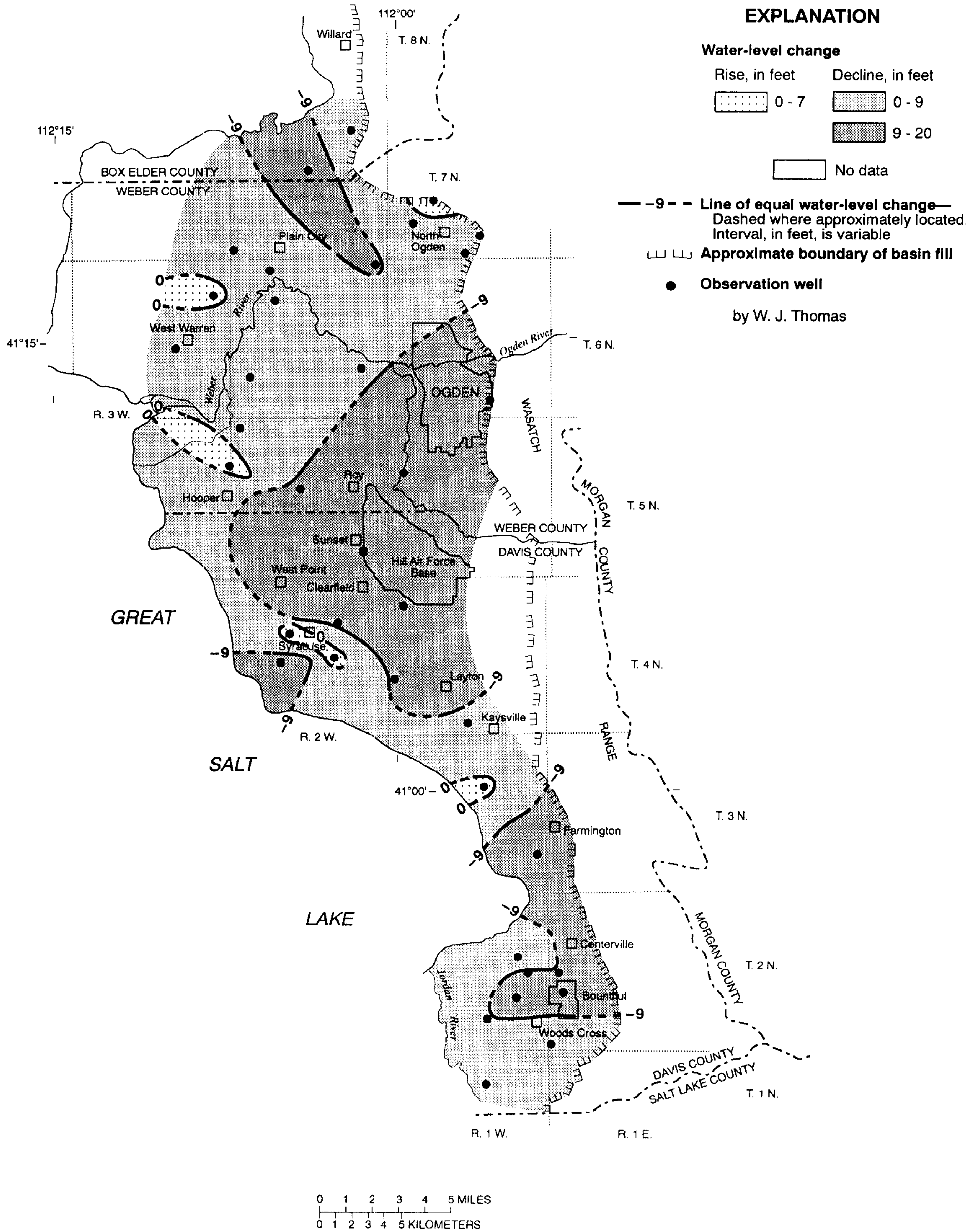

Figure 8. Map of the East Shore area showing change of water levels from March 1988 to March 1993.

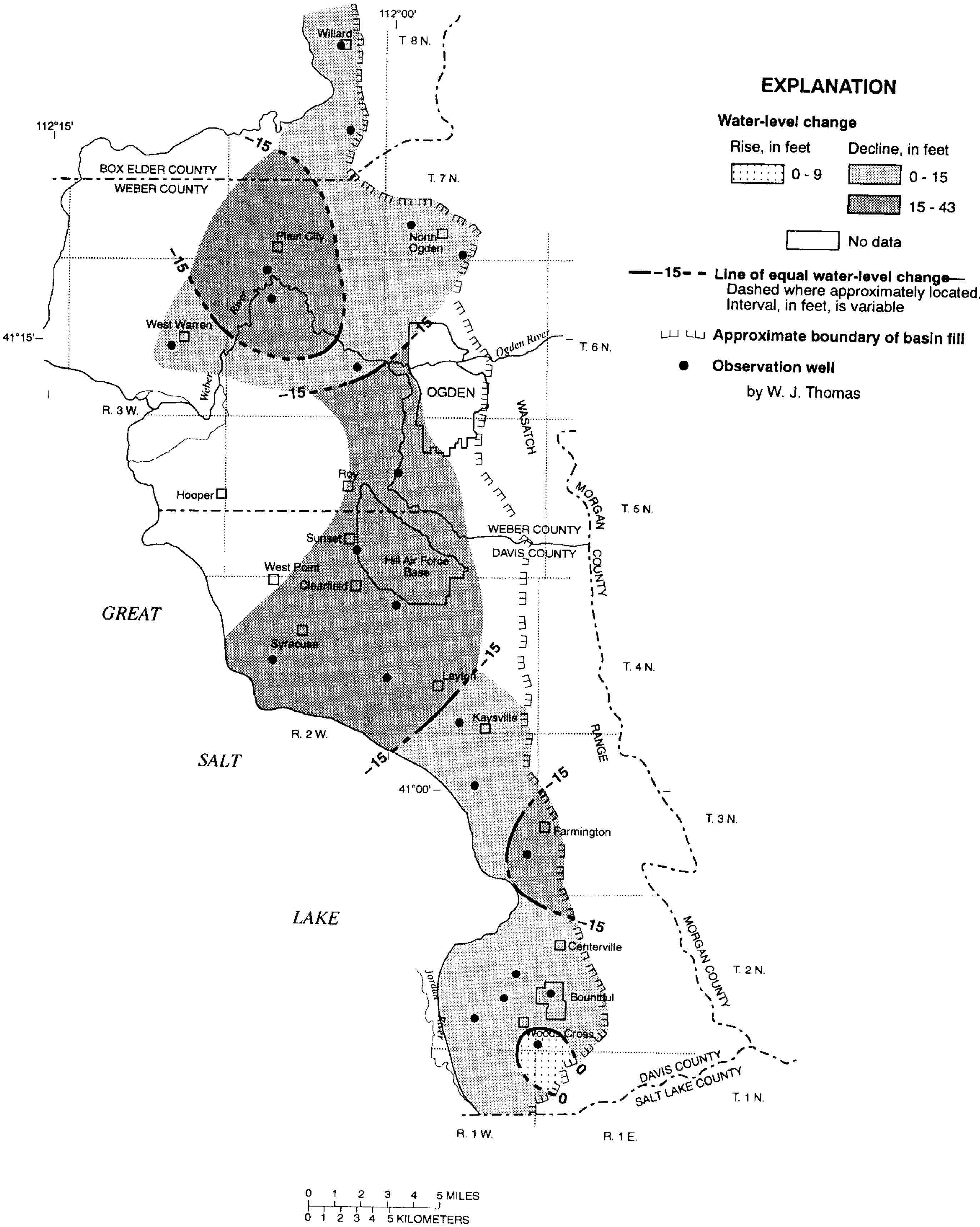

Figure 9. Map of the East Shore area showing change of water levels from March 1963 to March 1993.

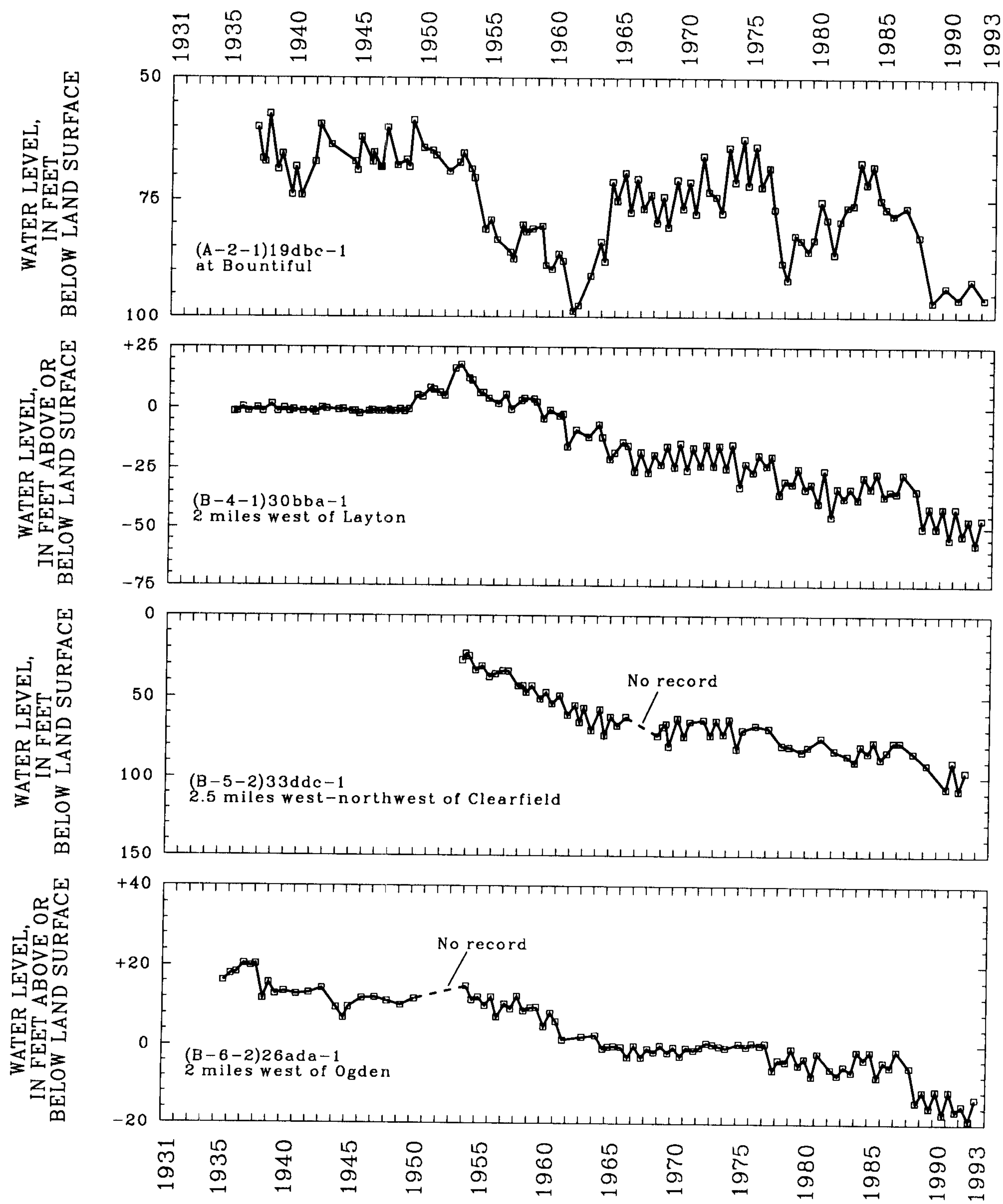

Figure 10. Relation of water levels in selected wells in the East Shore area to cumulative departure from the average annual precipitation at Ogden Pioneer Powerhouse, to annual withdrawals from wells, and to concentration of dissolved solids in water from well (B-4-2)27aba-1.

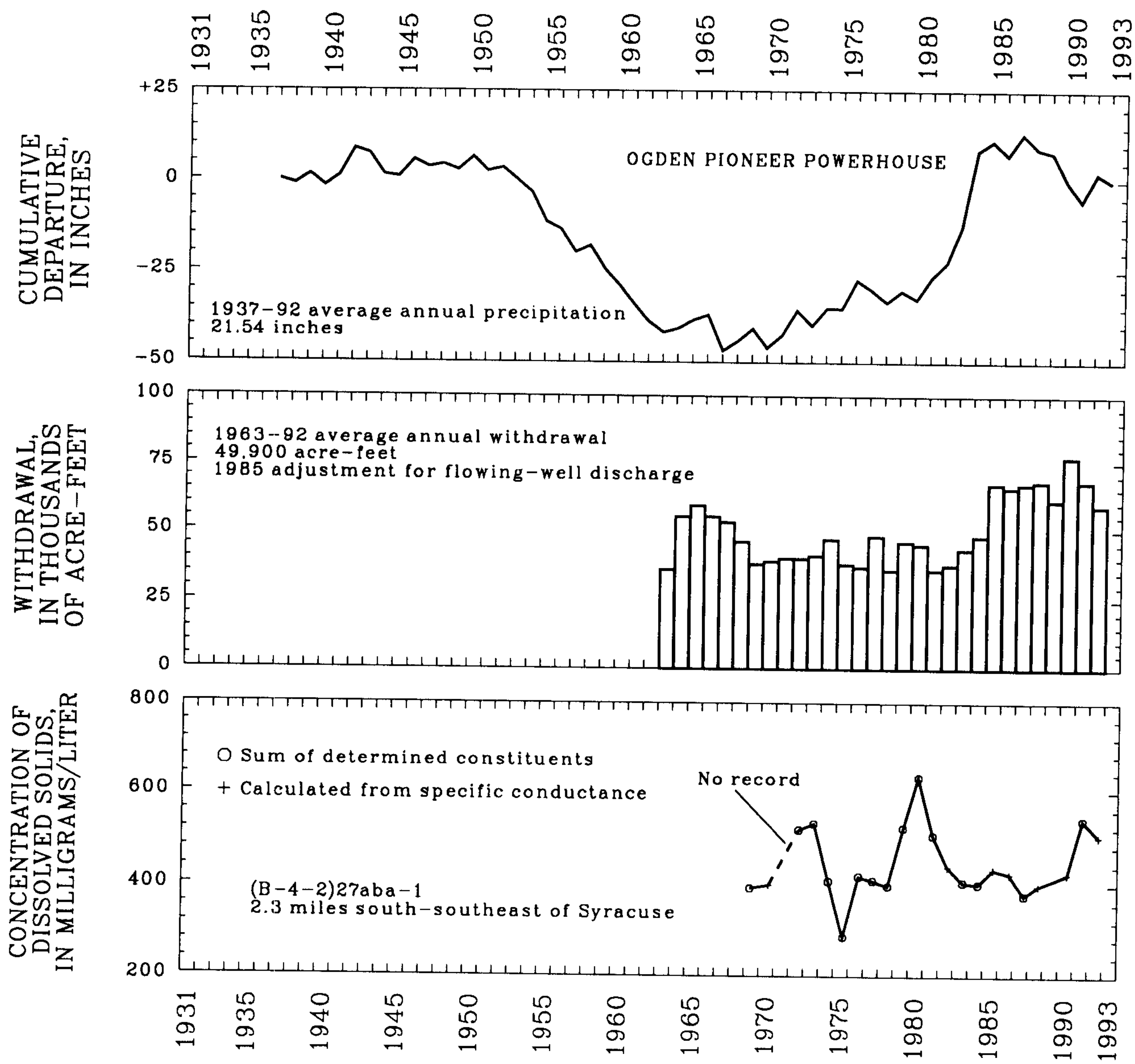

Figure 10. Relation of water levels in selected wells in the East Shore area to cumulative departure from the average annual precipitation at Ogden Pioneer Powerhouse, to annual withdrawals from wells, and to concentration of dissolved solids in water from well (B-4-2)27aba-1–Continued.

SALT LAKE VALLEY

by M.R. Greene

Withdrawal of water from wells in the Salt Lake Valley in 1992 was about 138,000 acre-feet, or about 3,000 acre-feet more than in 1991, and about 12,000 acre-feet more than the average annual withdrawal for 1982-91 (tables 2 and 3). Withdrawal for public supply was about 86,000 acre-feet, 16,800 acre-feet greater than the value for 1991. Withdrawal for industrial use in 1992 was 24,900 acre-feet, 13,700 acre-feet less than the quantity for 1991. The 1988-92 average annual withdrawal, 148,000 acre-feet, is 38,000 acre-feet more than the average for the preceding five-year period, 1983-87.

Water levels in the principal aquifer generally declined in most of Salt Lake Valley from February 1988 to February 1993 (fig. 11). The areas of greatest decline were east of Midvale and south of Holladay, and between Herriman and Riverton. The largest decline, 25.2 feet, was noted in a well west of Riverton. Water-level declines probably were the result of greater withdrawals and less precipitation during 1988-92 than during the preceding five-year period, 1983-87. Water-level rises occurred in three areas in the northern part of the valley. The largest rise, 6.6 feet, occurred in a well about 3 miles north of Murray.

Measured water-level changes generally indicated both rises and declines in water levels throughout the valley from February 1963 to February 1993 (fig. 12). The northeast and southwest corners of the valley had the greatest changes, with rises of 10.8 and 19.1 feet, respectively. The largest rise, 19.1 feet, was observed in a well northeast of Lark. The largest decline, about 9 feet, occurred in a well northwest of Riverton; however, extending the trends of hydrographs of two wells in which measurements couldn't be made in 1993 indicates declines of about 23 feet north-northeast of Midvale and about 43 feet northeast of Sandy. These declines are the result of the long-term large withdrawals of ground water in this part of the valley.

Estimated Salt Lake County population, total annual withdrawals from wells, annual withdrawal for public supply, and average annual precipitation at Salt Lake City Weather Service Office (WSO) (International Airport) are shown in figure 13. Precipitation at the Salt Lake City WSO during 1992 was 12.07 inches, 2.97 inches less than the average annual precipitation for 1931-92. The average annual precipitation for 1988-92, 12.14 inches, was 6.80 inches less than the average for the previous five-year period, 1983-87.

The relation of water levels in selected wells completed in the principal aquifer to cumulative departure from the annual average precipitation at Silver Lake near Brighton, and to concentration of chloride and dissolved solids in water from well (D-1-1)7abd-6 are shown in figure 14. Precipitation at Silver Lake near Brighton was 33.58 inches in 1992, 8.83 inches less than the average annual precipitation for 1931-92. The average precipitation during 1988-92, 35.52 inches, was 13.97 inches less than the average for the preceding five-year period, 1983-87.

The chloride concentration from well (D-1-1)7abd-6 (located in Artesian Well Park in Salt Lake City, and used by many people for drinking water) was 130 milligrams per liter in July 1992. This equals the highest recorded values measured in 1988, 1989, and 1991.

Water levels in two selected observation wells in the shallow unconfined aquifer in the northwestern part of the valley are shown in figure 15. The water level in the shallow well in Rose Park rose about 2.5 feet from February 1992 to February 1993; a measurement could not be made in February 1993 in the shallow well north of Magna.

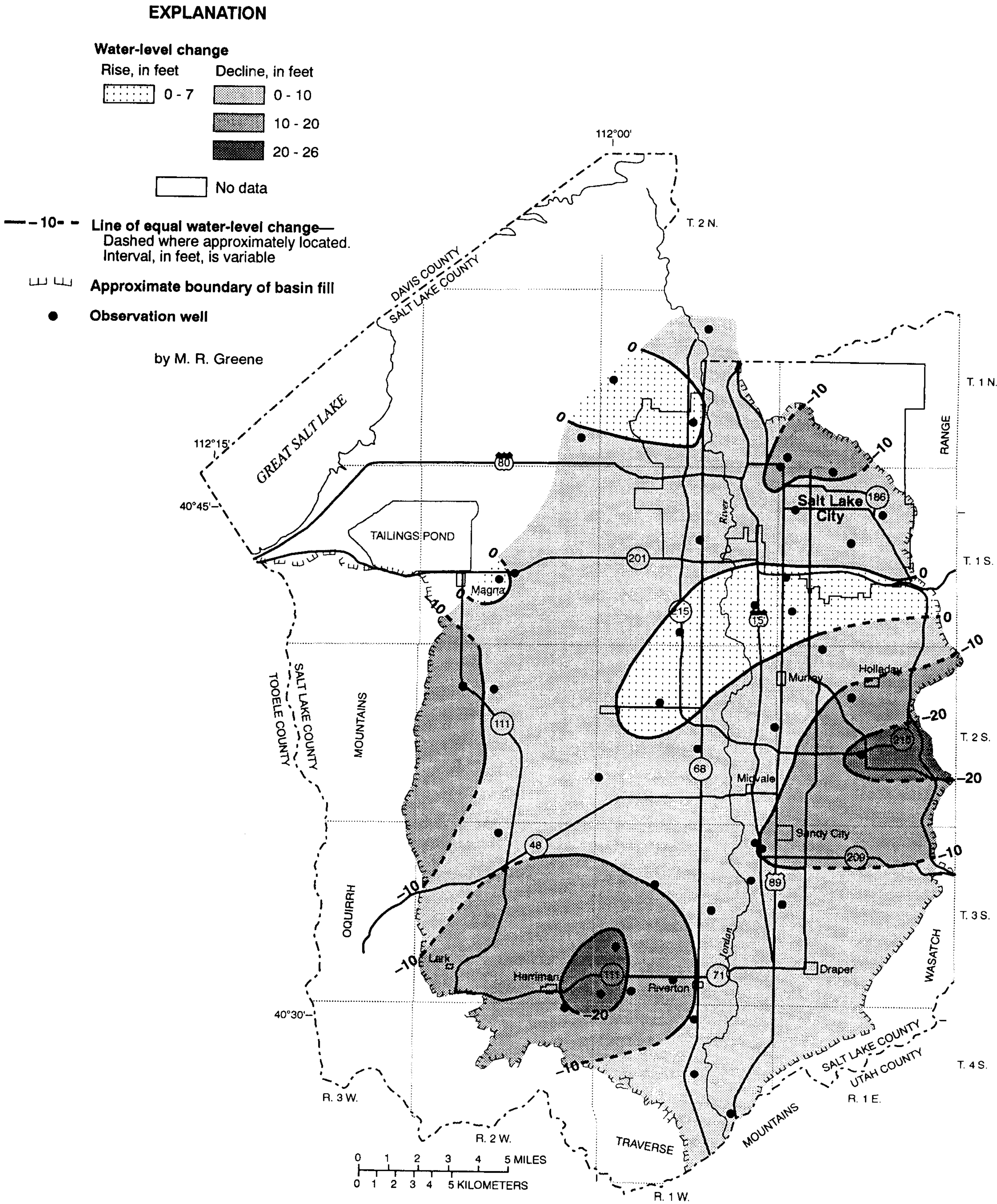

Figure 11. Map of the Salt Lake Valley showing change of water levels in the principal aquifer from February 1988 to February 1993.

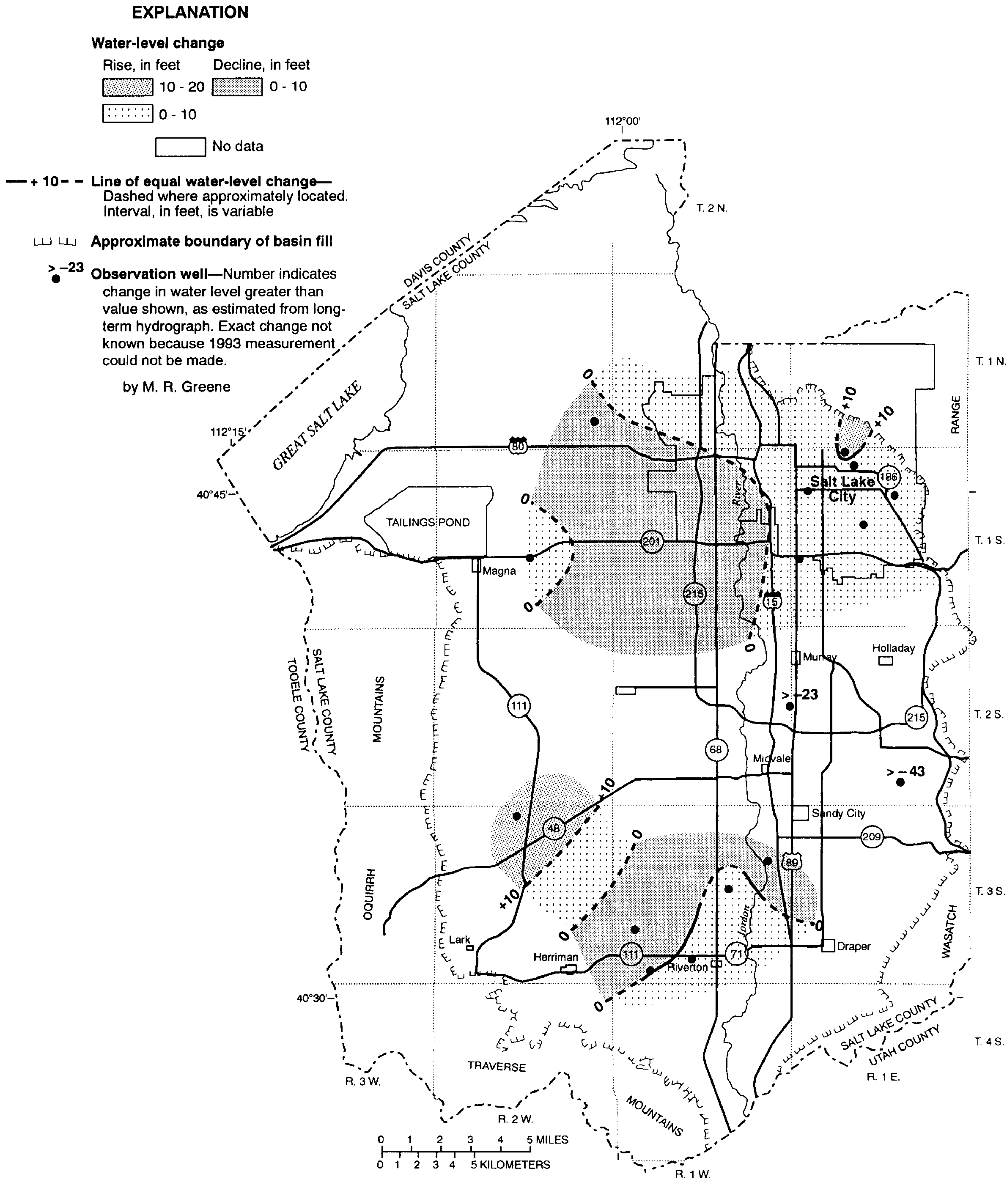

Figure 12. Map of the Salt Lake Valley showing change of water levels in the principal aquifer from February 1963 to February 1993.

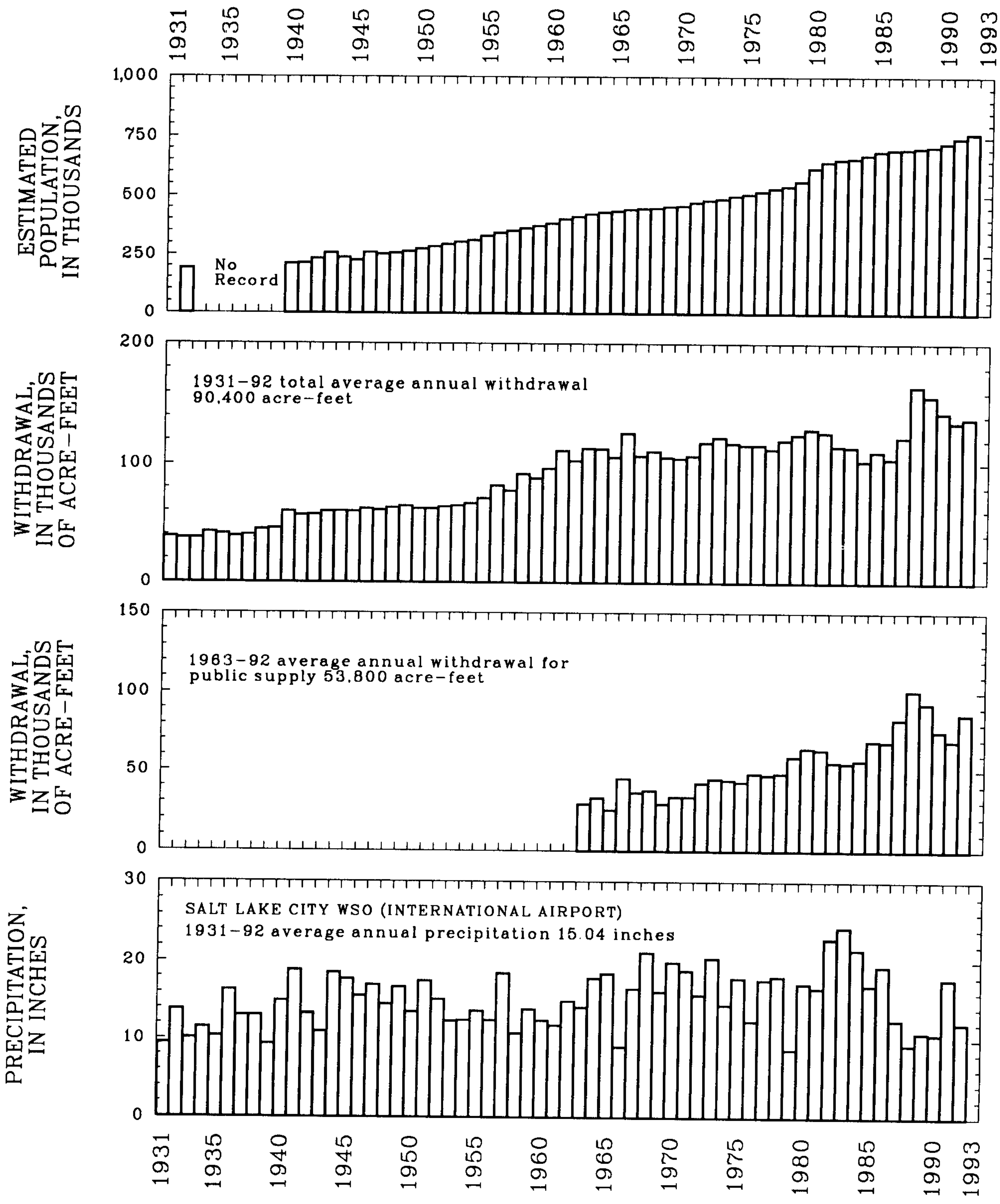

Figure 13. Estimated population of Salt Lake County, total annual withdrawals from wells, annual withdrawal for public supply, and average annual precipitation at Salt Lake City WSO (International Airport).

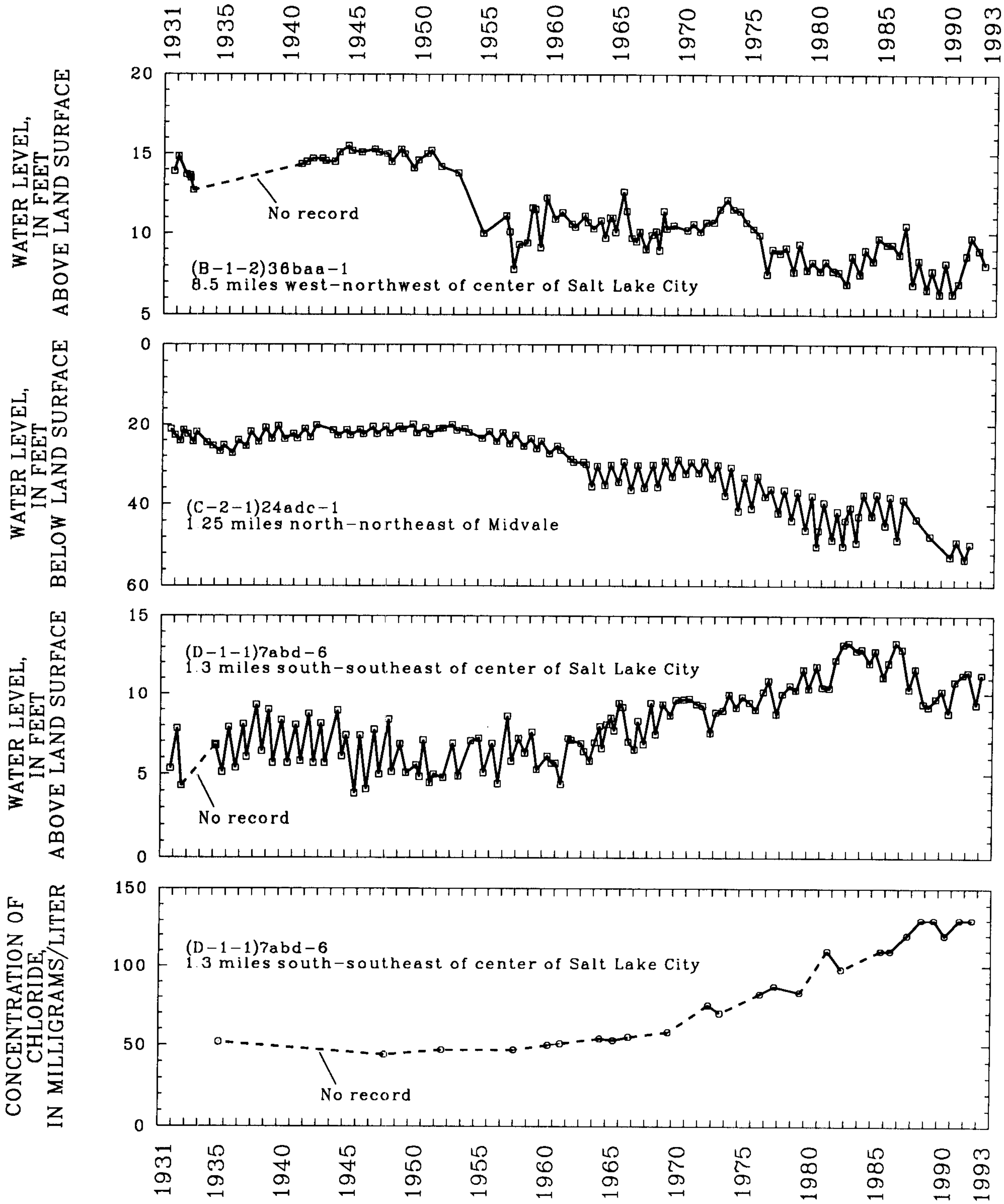

Figure 14. Relation of water levels in selected wells in the principal aquifer in Salt Lake Valley to cumulative departure from the average annual precipitation at Silver Lake Brighton, and relation of water levels in well (D-1-1)7abd-6 to concentration of chloride and dissolved solids in water from the well.

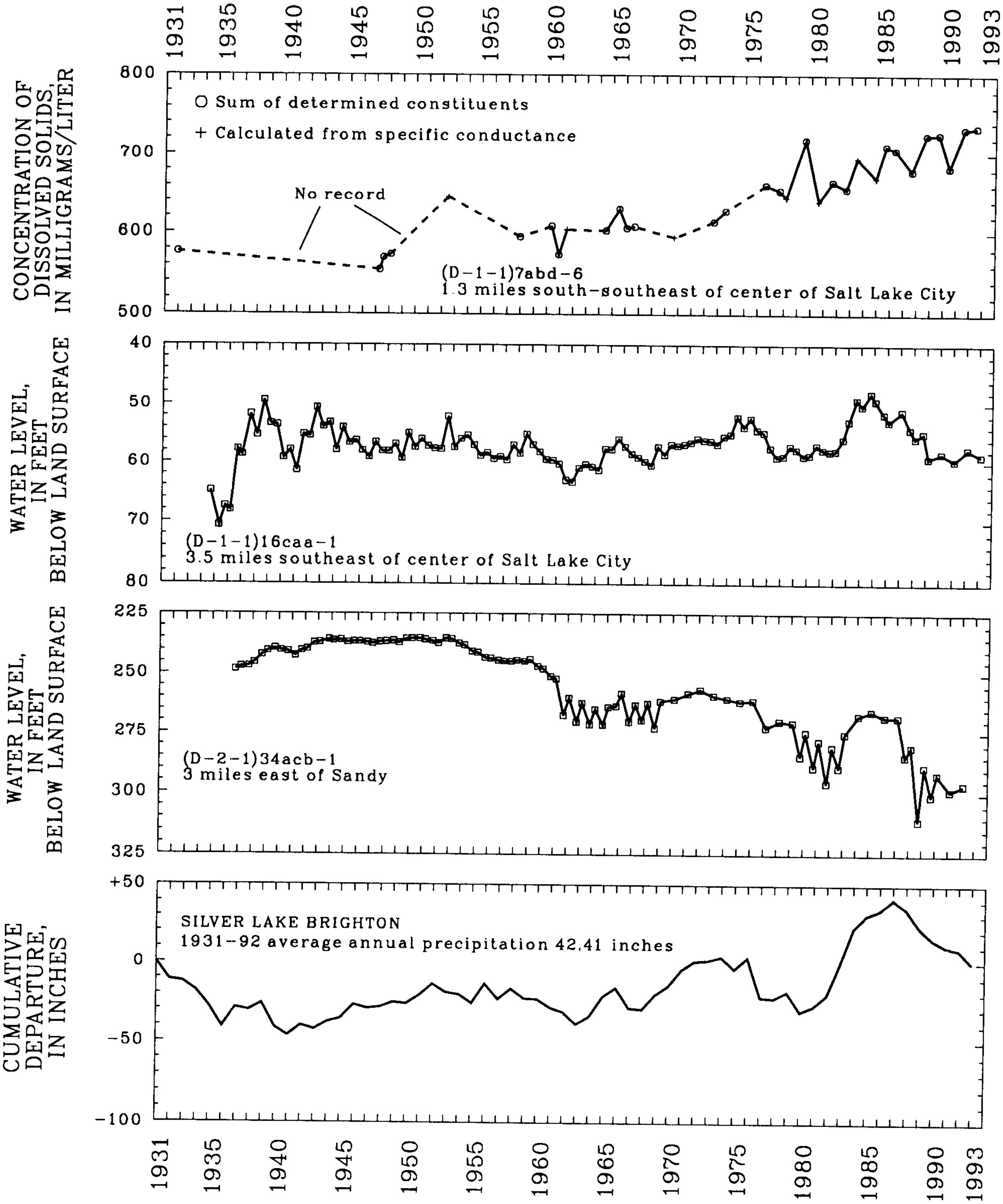

Figure 14. Relation of water levels in selected wells in the principal aquifer in Salt Lake Valley to cumulative departure from the average annual precipitation at Silver Lake Brighton, and relation of water levels in well (D-1-1)7abd-6 to concentration of chloride and dissolved solids in water from the well—Continued

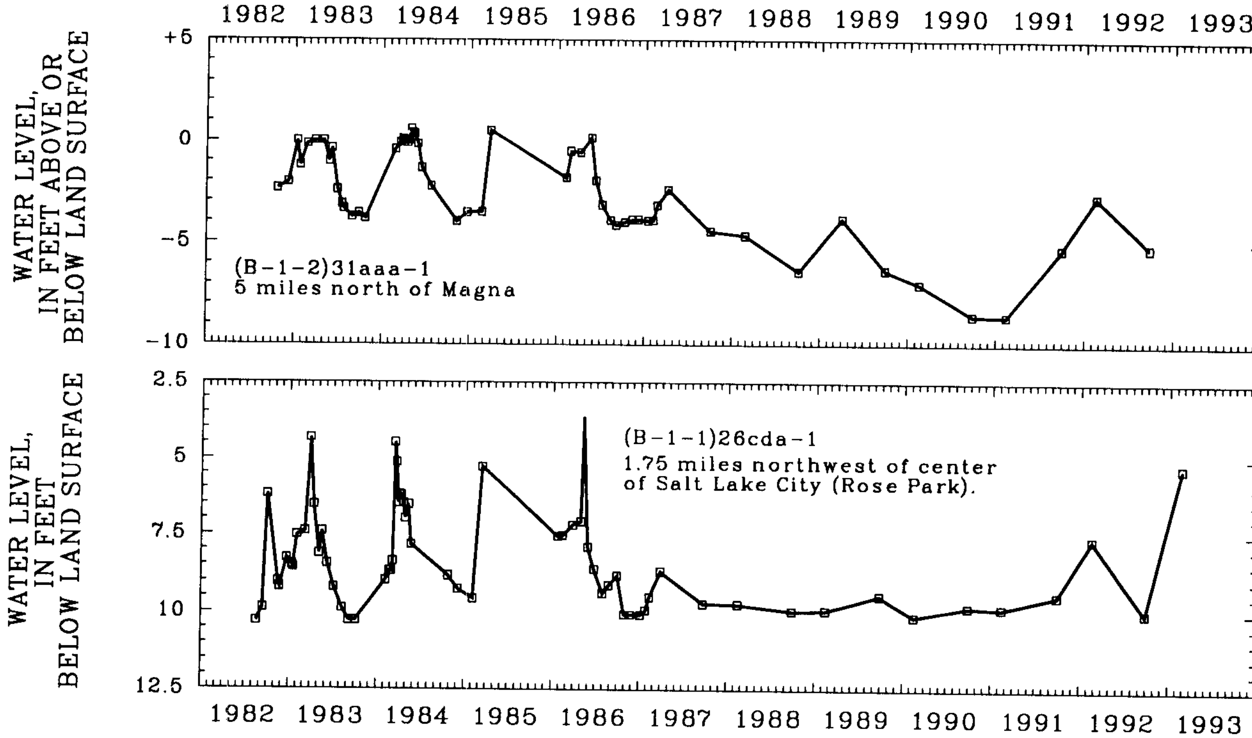

Figure 15. Water levels in selected wells in the shallow unconfined aquifer in Salt Lake Valley.

TOOELE VALLEY

by M.R. Danner

Withdrawal of water from wells in Tooele Valley in 1992 was about 30,000 acre-feet. This is the same value that was reported for 1991 and 5,000 acre-feet more than the average annual withdrawal for 1982-91 (tables 2 and 3). The average annual withdrawal for 1988-92, 29,000 acre-feet, was 7,000 acre-feet more than for the preceding five-year period, 1983-87.

Water levels declined throughout most of Tooele Valley from March 1988 to March 1993, with the largest declines occurring in the southeastern part of the valley. The maximum decline of about 30 feet was measured in a well about 2 miles north of Tooele (fig. 16). These declines probably are the result of two principal factors; increased withdrawals and a decrease in recharge for 1988-92 as compared with the previous five-year period, 1983-87. The recharge rate decreased because of less precipitation during 1988-92 than during 1983-87. Water levels rose about 1 foot in an area north of Grantsville from March 1988 to March 1993.

Water levels generally rose from March 1963 to March 1993 (fig. 17) in the northeastern part of the valley. Most water-level rises were less than 10 feet; however, a rise of 21.8 feet was measured in a well 3 miles west of Erda. Water-level rises from 1963 to 1993 may be related to precipitation being above the long-term (1936-92) average during 1963-92, and especially during 1982-87, which resulted in increased recharge. Rises in the area around Erda also may be partly related to discharge of water from a mine east of Erda from 1972 to at least 1978. The mine-discharge water flowed into Tooele Valley and locally increased recharge, raising water levels in Erda 12 to 15 feet during 1972-76 (Razem and Steiger, 1981, p. 23).

Water-level declines occurred in the areas adjacent to and north of Grantsville. The largest decline, nearly 7 feet, was measured in a well northeast of Grantsville. Water-level declines during 1988-92 may be the result of increased withdrawals in areas where less surface water is available for irrigation and recharge. No data were available for the southern part of the valley around Tooele and the Tooele Army Depot.

The relation of water levels in selected wells in Tooele Valley to cumulative departure from the average annual precipitation at Tooele, to annual withdrawals from wells, and to concentration of dissolved solids in water from well (C-2-6)23cbb-1 is shown in figure 18. Precipitation during 1992 at Tooele was 12.84 inches, 8.12 inches less than in 1991 and 4.47 inches less than the average annual precipitation for the period 1936-92. Average annual precipitation at Tooele for 1988-92, 16.38 inches, was 7.83 inches less than the average for the previous five years, 1983-87. The concentration of dissolved solids in water from well (C-2-6)23cbb-1 has generally declined since 1960, and particularly since 1982, although no data are available for 1992.

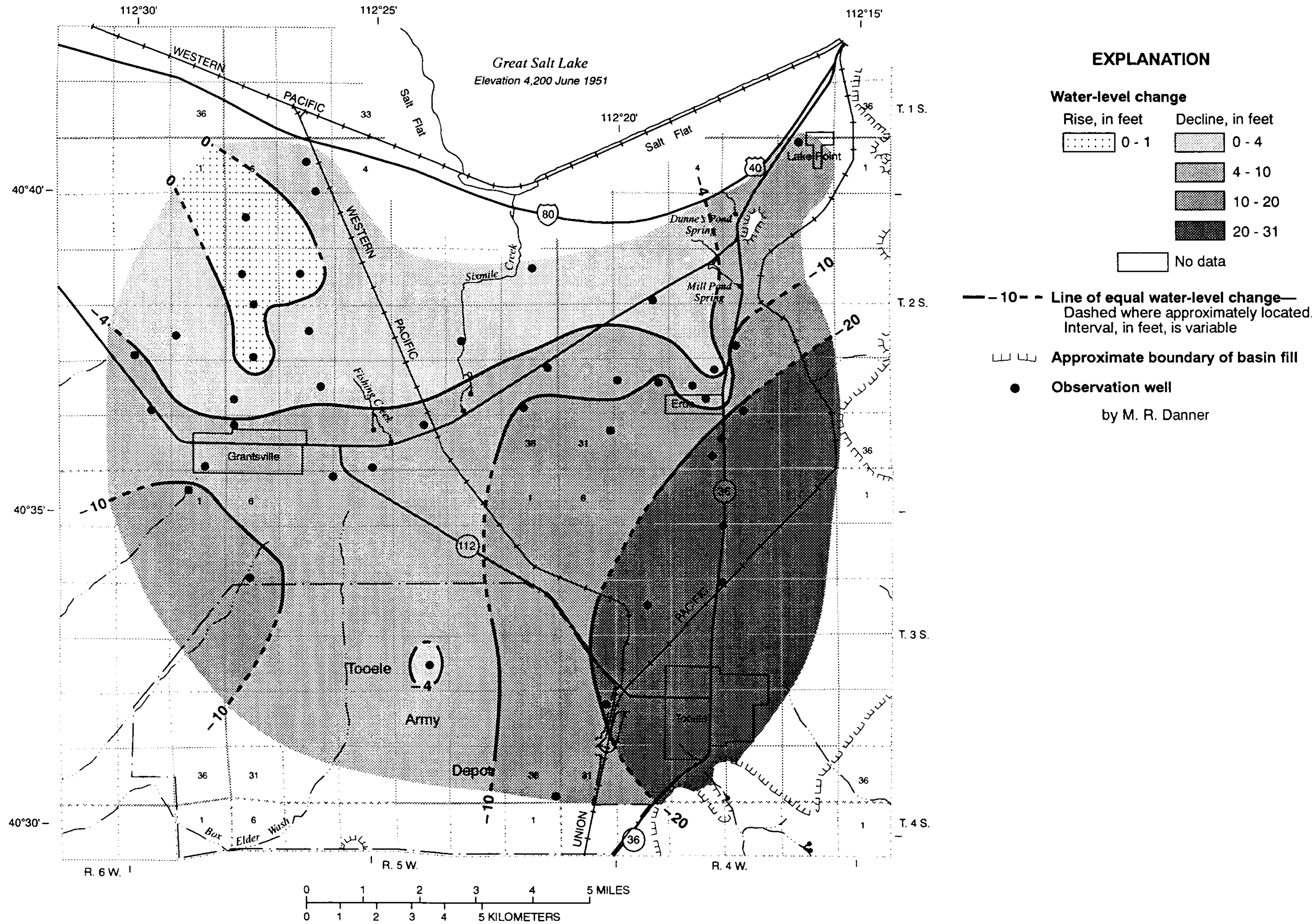

Figure 16. Map of Tooele Valley showing change of water levels from March 1988 to March 1993.

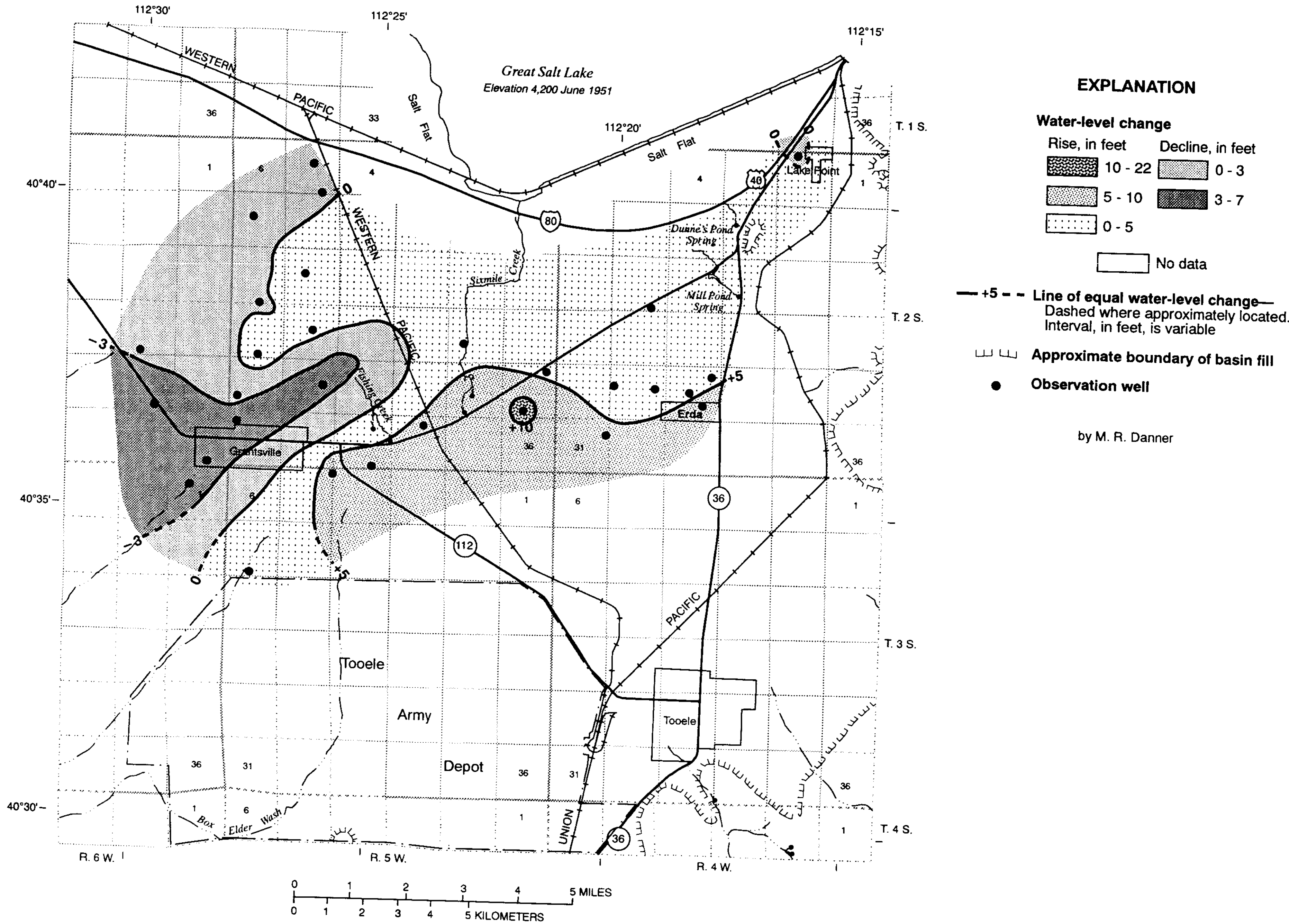

Figure 17. Map of Tooele Valley showing change of water levels from March 1963 to March 1993.

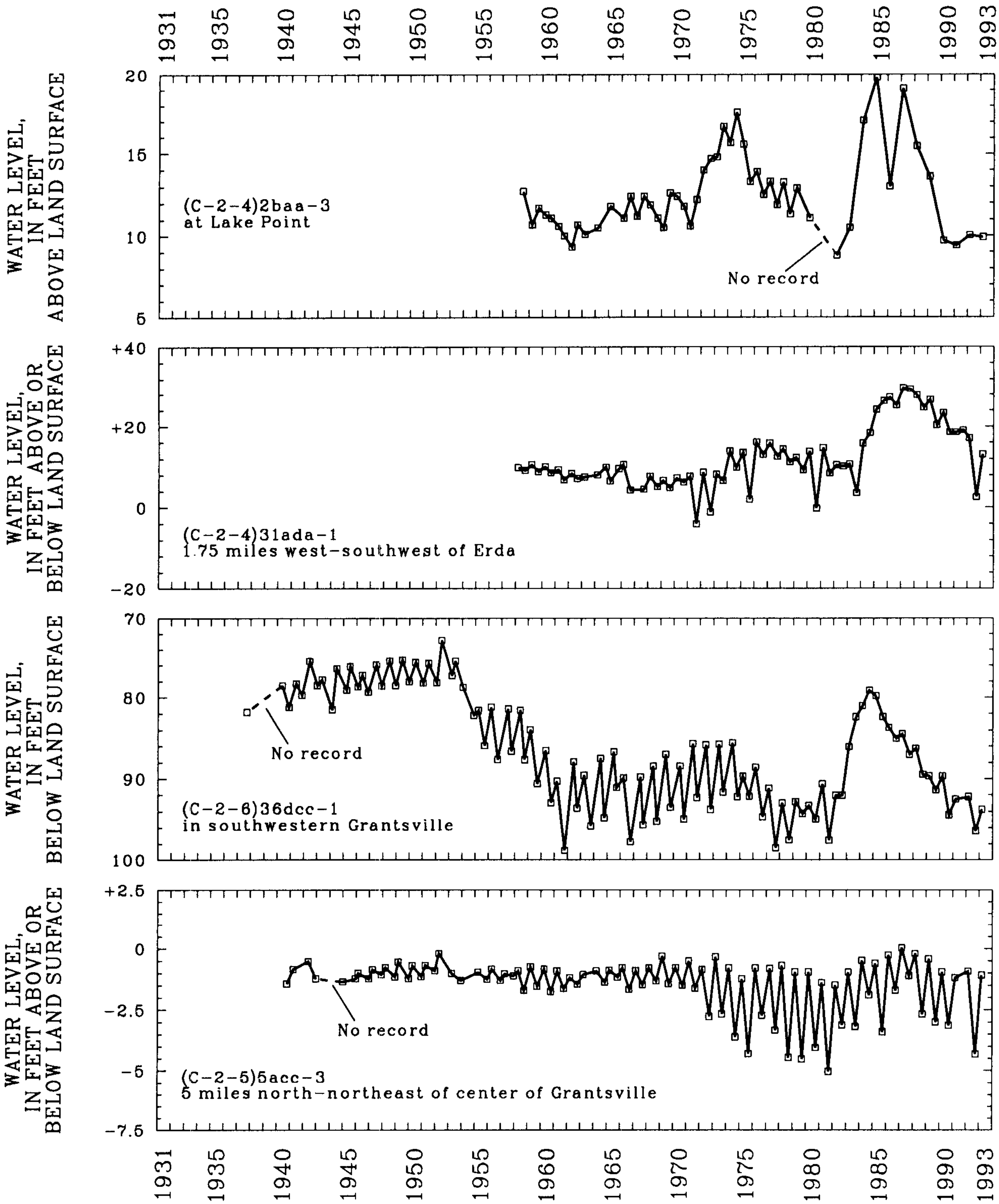

Figure 18. Relation of water levels in selected wells in Tooele Valley to cumulative departure from the average annual precipitation at Tooele, to annual withdrawals from wells, and to concentration of dissolved solids in water from well (C-2-6)23cbb-1.

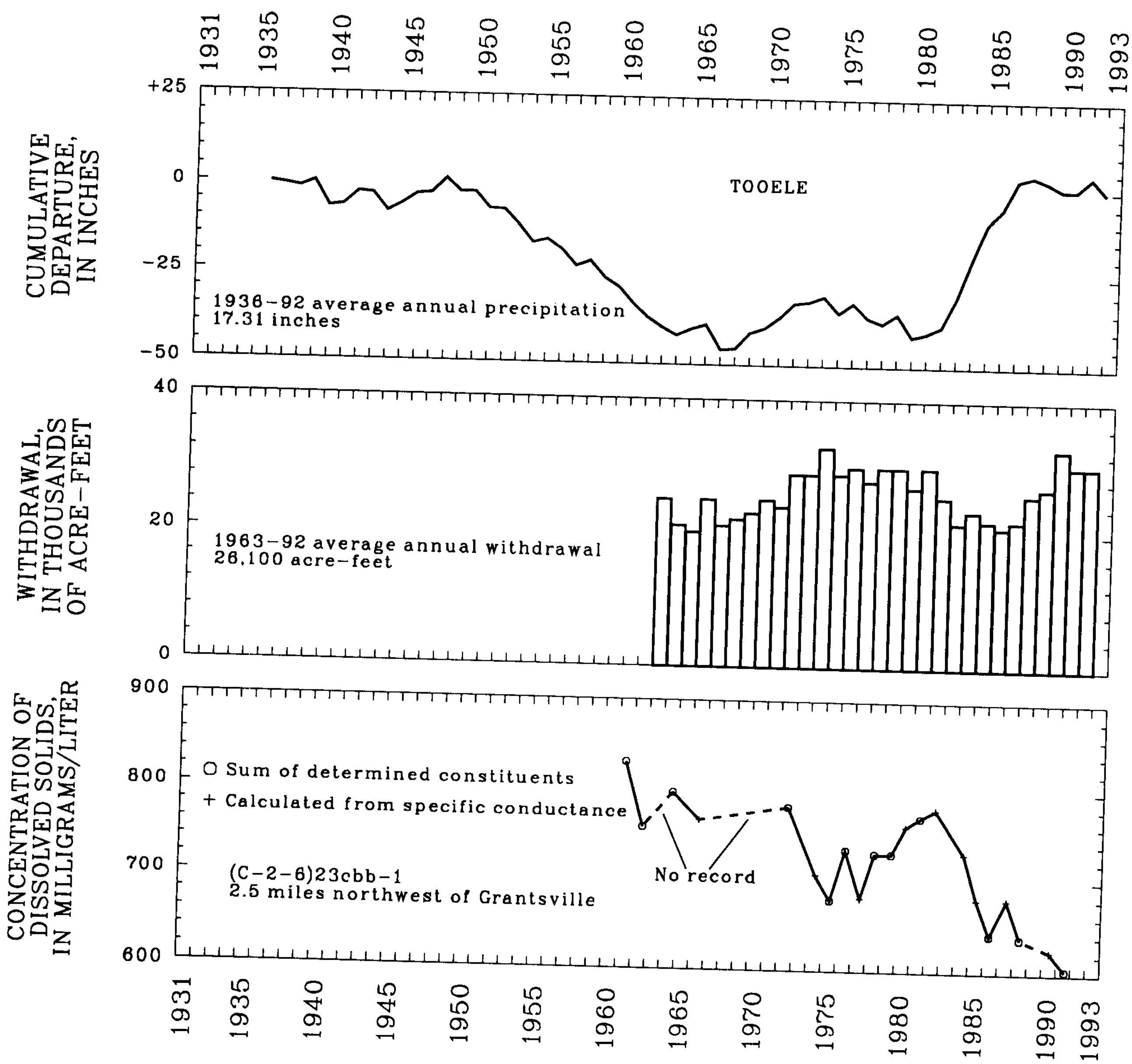

Figure 18. Relation of water levels in selected wells in Tooele Valley to cumulative departure from the average annual precipitation at Tooele, to annual withdrawals from wells, and to concentration of dissolved solids in water from well (C-2-6)23cbb-1—Continued.

UTAH AND GOSHEN VALLEYS

by L.R. Herbert

Withdrawal of water from wells in Utah and Goshen Valleys in 1992 was about 141,000 acre-feet, the largest withdrawal recorded since data collection began in 1963. The 1992 withdrawal was 17,000 acre-feet more than the withdrawal in 1991, and 42,000 acre-feet more than the average annual withdrawal for 1982-91 (tables 2 and 3). The 1988-92 average annual withdrawal of 126,000 acre-feet was 42,000 acre-feet more than for the preceding five-year period, 1983-87. Withdrawal in Utah Valley was about 126,600 acre-feet, 18,000 acre-feet more than in 1991. Withdrawal in Goshen Valley was about 14,400 acre-feet, 1,400 acre-feet less than in 1991. The increase in Utah Valley was primarily the result of increased withdrawals for public supply.

Water levels generally declined in Utah and Goshen Valleys from March 1988 to March 1993, with the exception of an area of about 5 feet of rise in Goshen Valley (fig. 19). The declines in all of Utah Valley and most of Goshen Valley were the result of increased withdrawals of water from wells during 1988-92 compared with withdrawals during the preceding five-year period, 1983-87, and decreased recharge from less precipitation during 1988-92 compared with the preceding five-year period, 1983-87. The largest decline, about 20 feet, was measured east of Lehi. The slight rise in water levels in Goshen Valley, north of Elberta, may be the result of a local decrease in pumpage during 1988-92.

Water levels generally declined in all of Utah Valley and part of Goshen Valley from March 1963 to March 1993 (fig. 20). Maximum declines of about 11 feet were observed in both valleys. The declines probably were the result of increased withdrawals for public supply and irrigation use. Rises of about 5 feet were observed in Goshen Valley near Elberta. The rises probably were the result of decreased withdrawals for irrigation.

The relation of water levels in selected observation wells to cumulative departure from the average annual precipitation at Timpanogos Cave and Spanish Fork Powerhouse, to annual withdrawals for public supply, to total annual withdrawals from wells, and to concentration of dissolved solids in water from three observation wells is shown in figure 21.

The average annual precipitation at Timpanogos Cave during 1988-92 was 21.14 inches, 8.94 inches less than the average during 1983-87. Average annual precipitation for 1988-92 at Spanish Fork Powerhouse was 17.10 inches, 9.47 inches less than the average during 1983-87. The water level in observation well (D-9-2)11aaa-1 in the city of Salem rose about 35 feet during 1982-84 and declined about 48 feet during 1985-93. The rise approximately corresponded to above-average precipitation during 1981-86 and lower withdrawals during 1982-86. The decline in the water level since 1984 more closely corresponded to lower precipitation during 1987-92 than during the previous six years, and to increased withdrawals during 1987-92 than during the previous five years.

Dissolved-solids concentration in water from well (C-10-1)4cbb-1 increased during 1977-86, and may have decreased since 1986. Dissolved-solids concentration in water from well (D-5-1)19ccc-1 decreased from 1983 to 1991, but appears to have increased from 1991 to 1992.

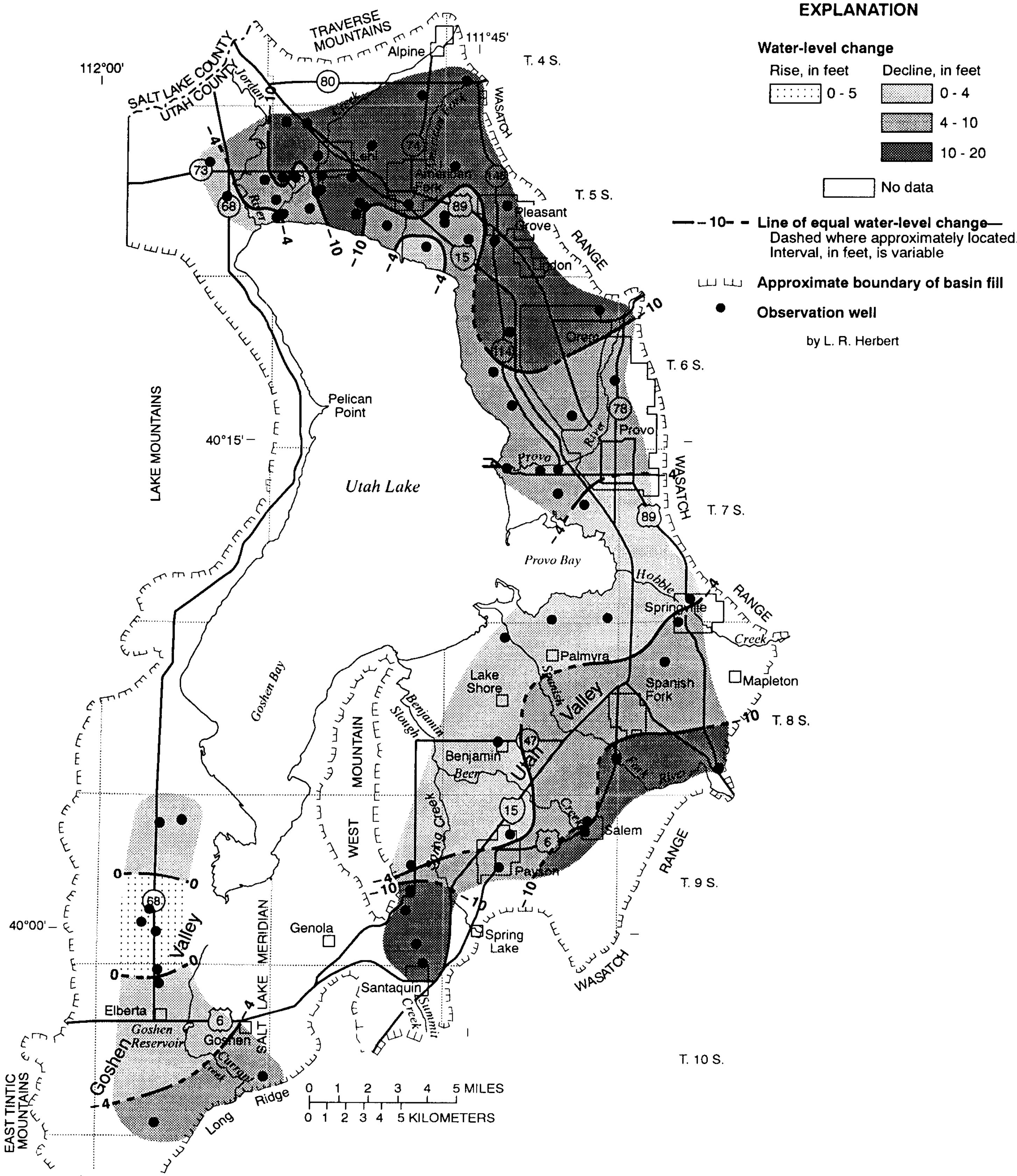

Figure 19. Map of Utah and Goshen Valleys showing change of water levels from March 1988 to March 1993.

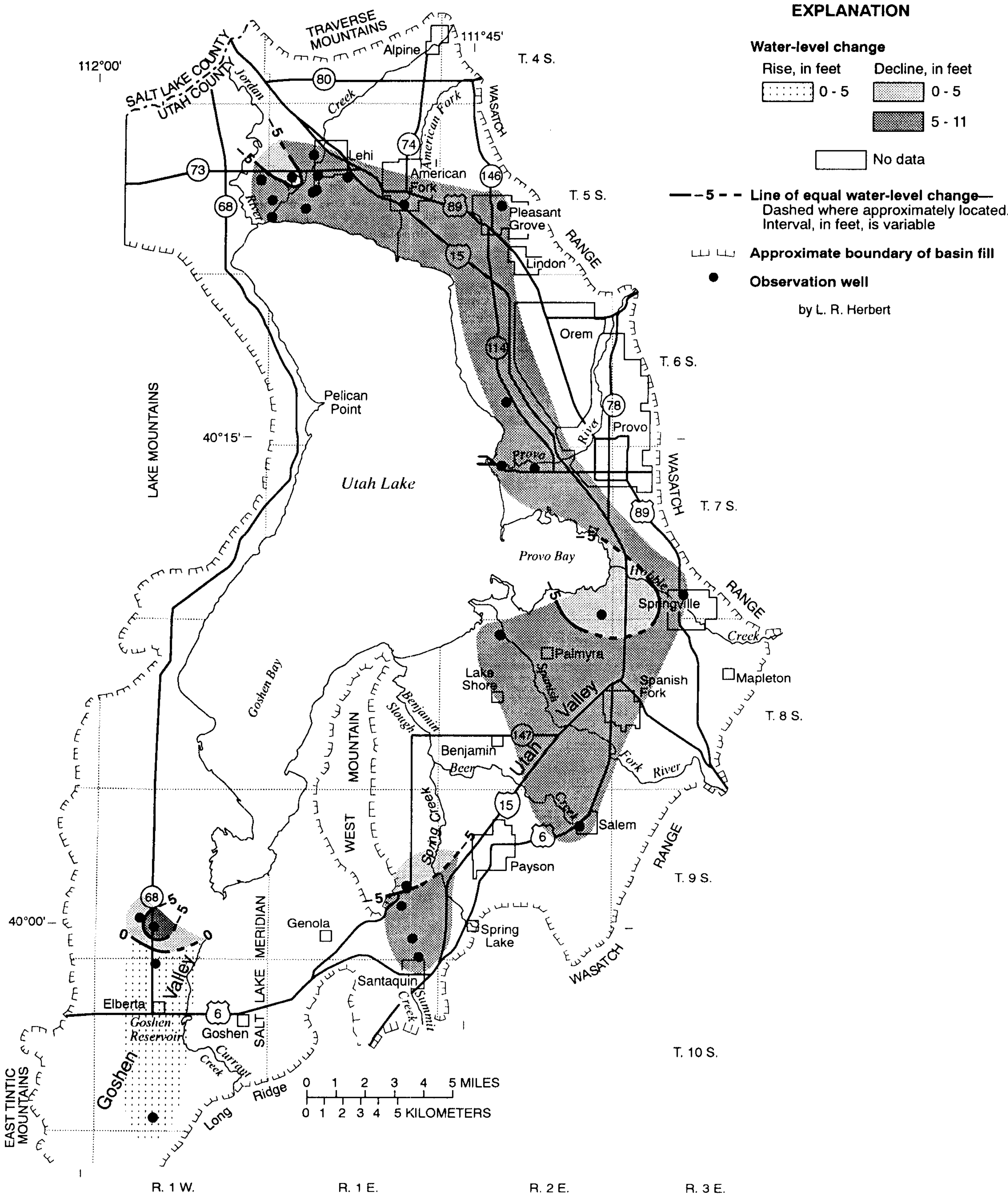

Figure 20. Map of Utah and Goshen Valleys showing change of water levels from March 1963 to March 1993

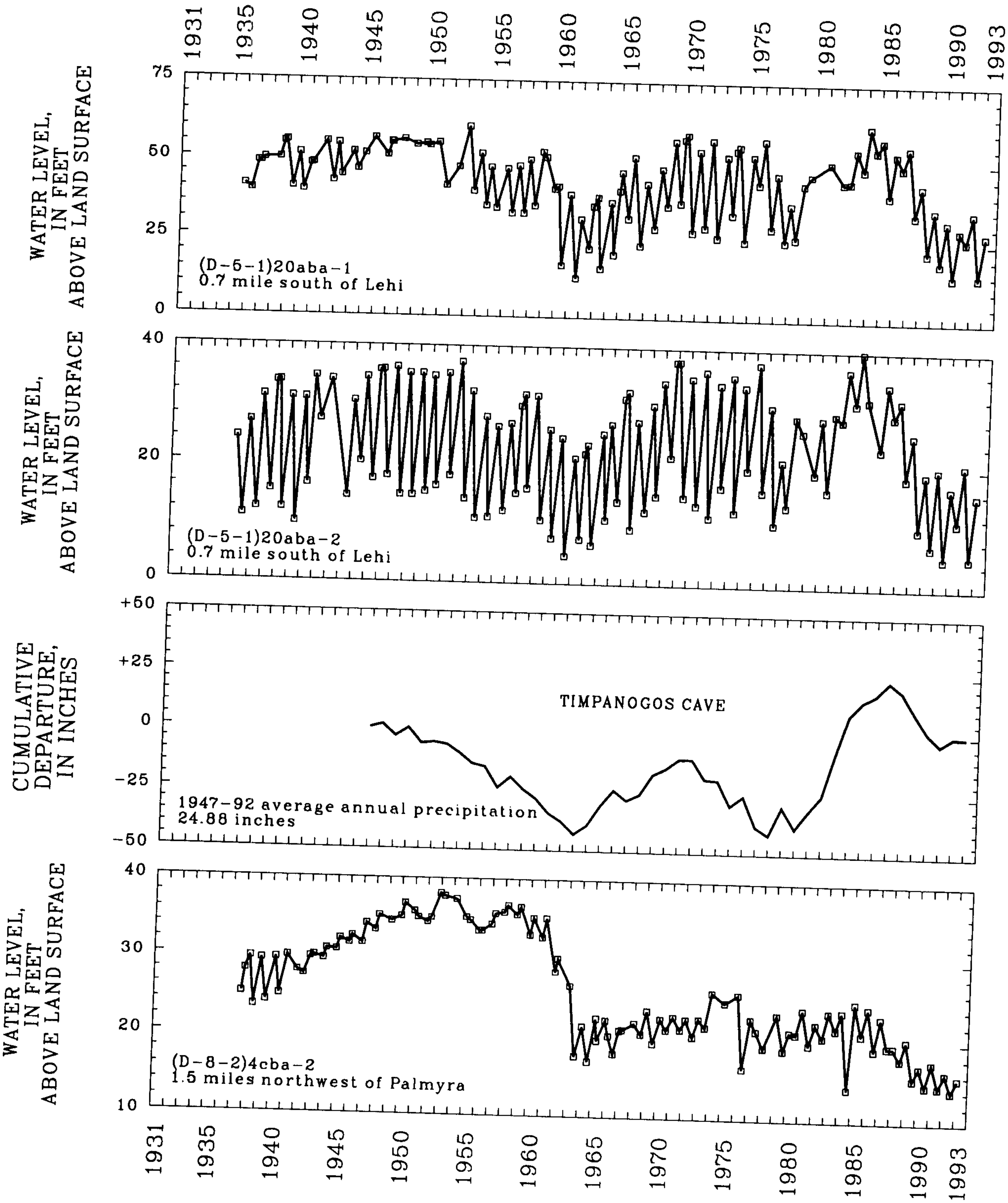

Figure 21. Relation of water levels in selected wells in Utah and Goshen Valleys to cumulative departure from the average annual precipitation at Timpanogos Cave and Spanish Fork Powerhouse, to annual withdrawals for public supply, to total annual withdrawals from wells, and to concentration of dissolved solids in water from selected wells.

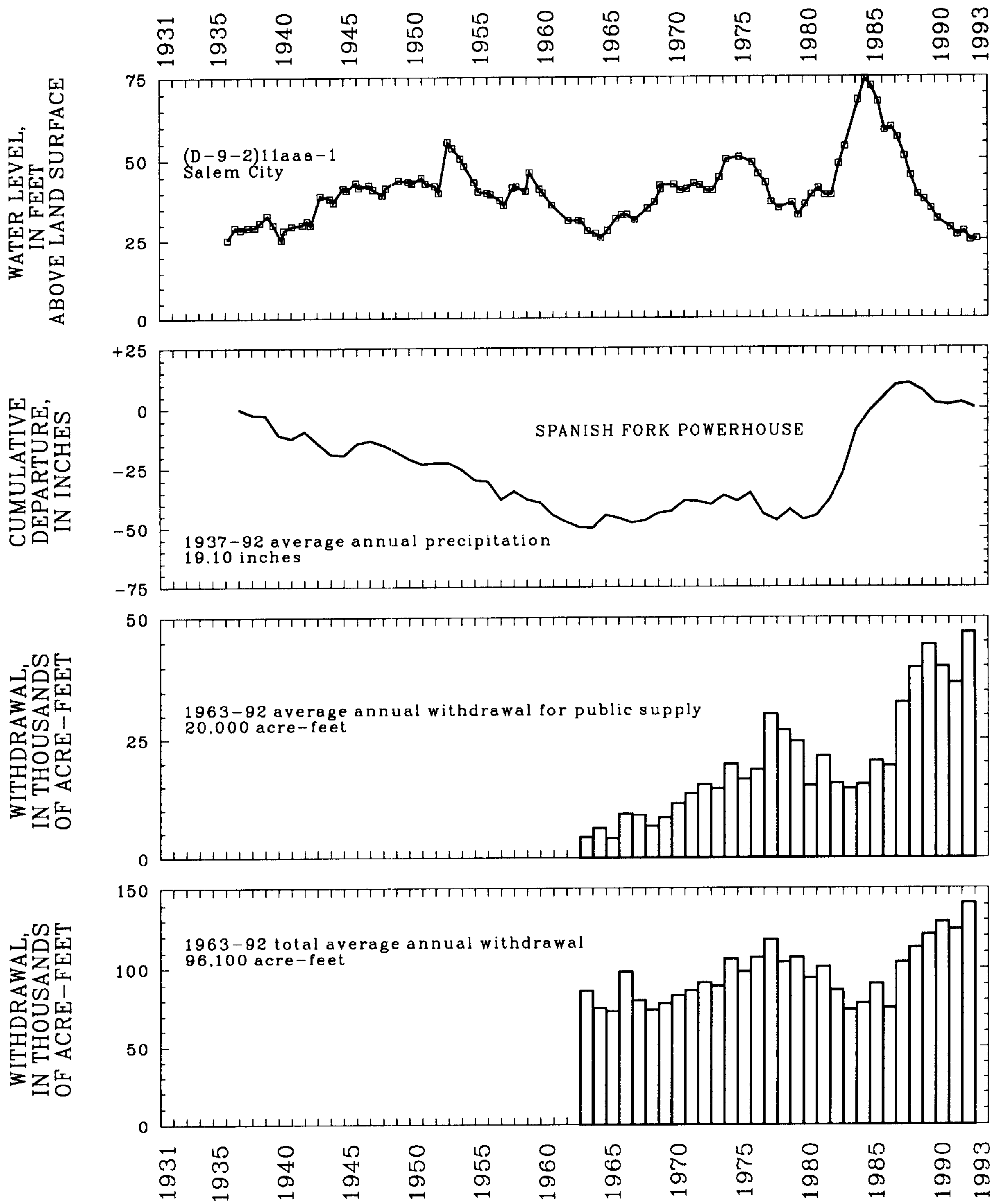

Figure 21. Relation of water levels in selected wells in Utah and Goshen Valleys to cumulative departure from the average annual precipitation at Timpanogos Cave and Spanish Fork Powerhouse, to annual withdrawals for public supply, to total annual withdrawals from wells, and to concentration of dissolved solids in water from selected wells—Continued.

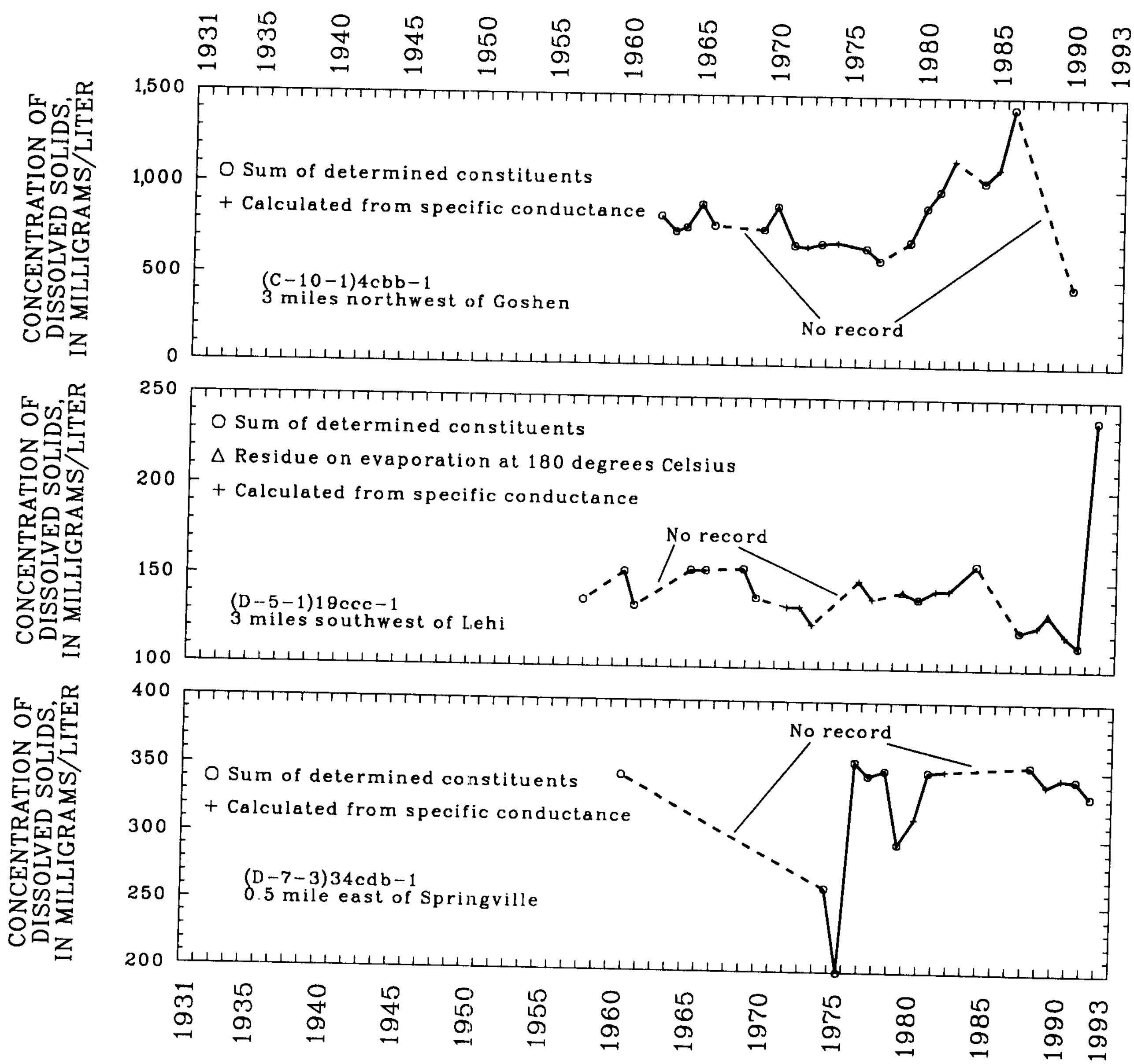

Figure 21. Relation of water levels in selected wells in Utah and Goshen Valleys to cumulative departure from the average annual precipitation at Timpanogos Cave and Spanish Fork Powerhouse, to annual withdrawals for public supply, to total annual withdrawals from wells, and to concentration of dissolved solids in water from selected wells—Continued.

JUAB VALLEY

by H.K. Hadley

Withdrawal of water from pumped and flowing wells in Juab Valley in 1992 was about 29,000 acre-feet. This is 4,000 acre-feet more than was reported for 1991 and 12,000 acre-feet more than the average annual withdrawal for 1982-91 (tables 2 and 3). The average annual withdrawal for 1988-92, 26,000 acre-feet, was 15,000 acre-feet more than for the preceding five-year period, 1983-87, mainly because of greater withdrawals for irrigation. The increased withdrawals for irrigation are the result of less available surface water because of less precipitation during 1988-92 than during 1983-87.

Water levels declined throughout Juab Valley from March 1988 to March 1993. Declines of as much as 26 feet were recorded in the irrigated areas near Mona and Nephi. The largest decline, 62.4 feet, was measured north of Levan (fig. 22). The declines are related to increased withdrawals for irrigation and less recharge from less-than-average precipitation and streamflow during 1988-92 as compared with the preceding five-year period, 1983-87.

Water levels declined in most areas of Juab Valley during March 1963 to March 1993 (fig. 23). Declines of as much as 8 to 11 feet were recorded in the irrigated areas near Mona and Nephi. The largest decline, about 21 feet, was recorded near Levan. The declines are probably related to above-average withdrawals for irrigation during 1987-92. Water levels rose less than 6 feet in a small area northwest of Levan, probably because of decreased local withdrawals.

The relation of water levels in selected wells to cumulative departure from the average annual precipitation at Nephi, to annual withdrawals from wells, and to concentration of dissolved solids in water from well (D-13-1)7dbc-1 is shown in figure 24. Precipitation at Nephi during 1992 was 14.48 inches, which is 0.23 inch more than the average annual precipitation for 1935-92. The 1988-92 average annual precipitation was 13.18 inches, which is 5.13 inches less than the average for the preceding five-year period, 1983-87. The concentration of dissolved solids in water from well (D-13-1)7dbc-1 fluctuated from 1964-91, but generally increased. No data are available for 1992.

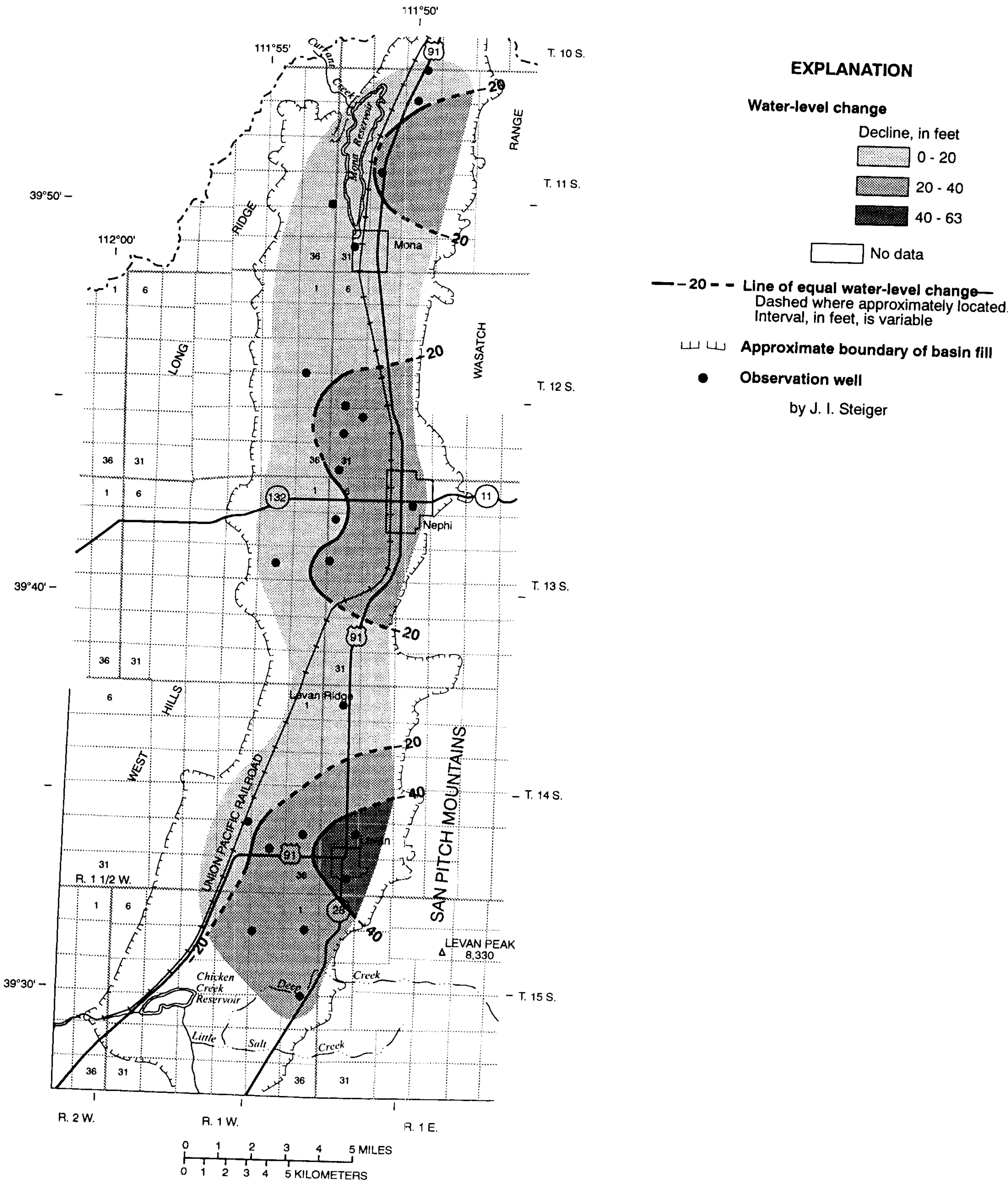

Figure 22. Map of Juab Valley showing change of water levels from March 1988 to March 1993.

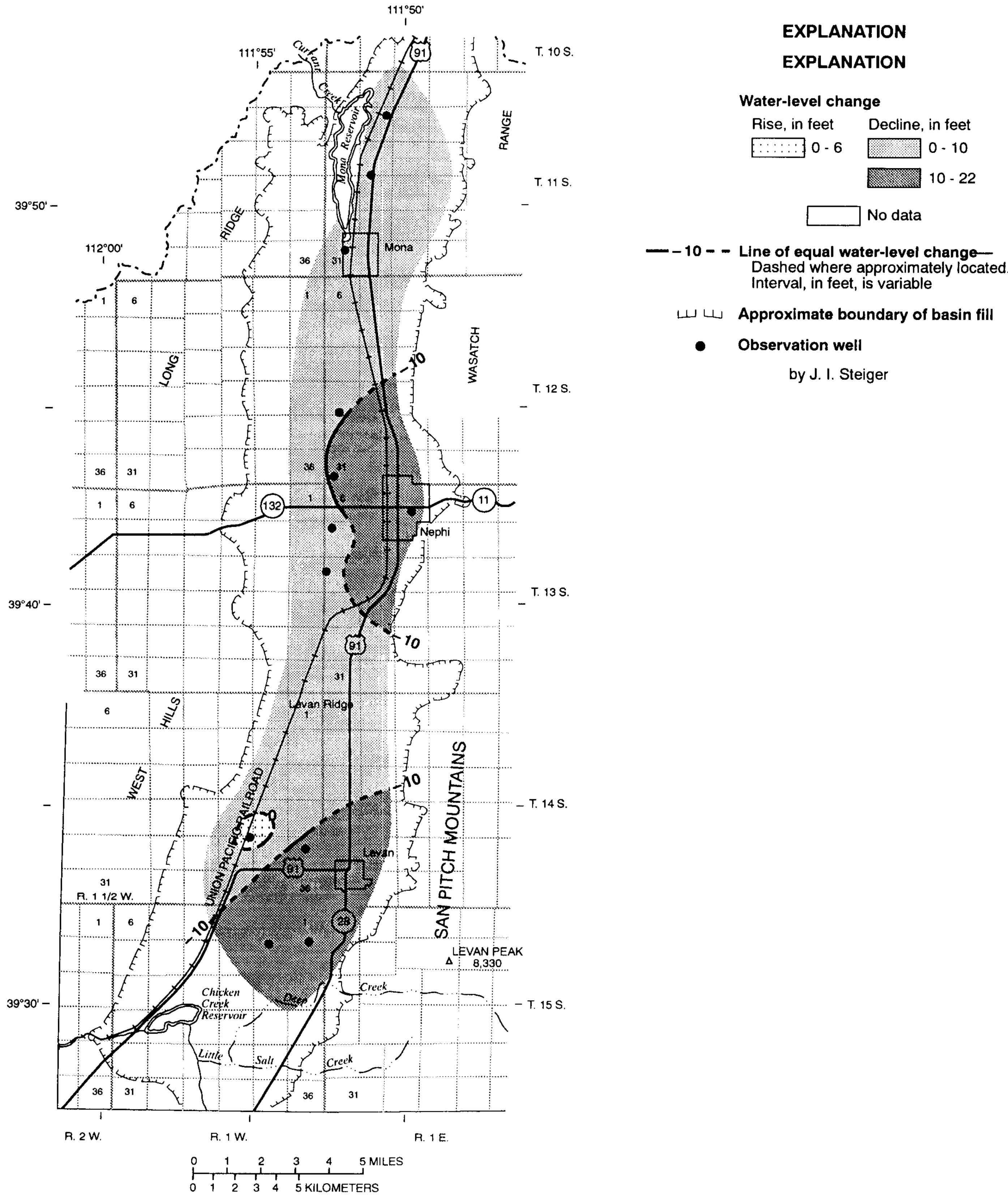

Figure 23. Map of Juab Valley showing change of water levels from March 1963 to March 1993.

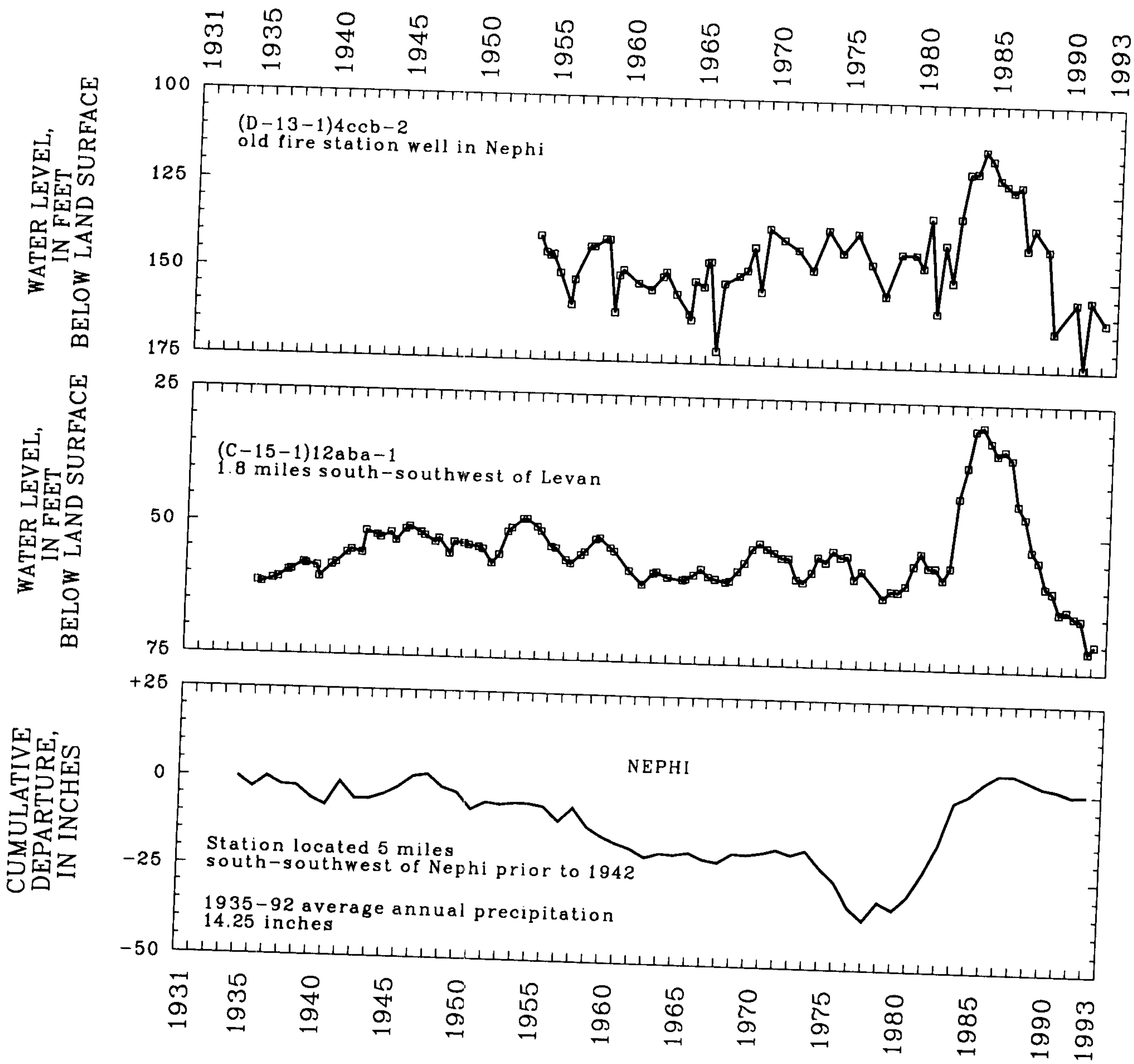

Figure 24. Relation of water levels in selected wells in Juab Valley to cumulative departure from the average annual precipitation at Nephi, to annual withdrawals from wells, and to concentration of dissolved solids in water from well (D-13-1)7dbc-1.

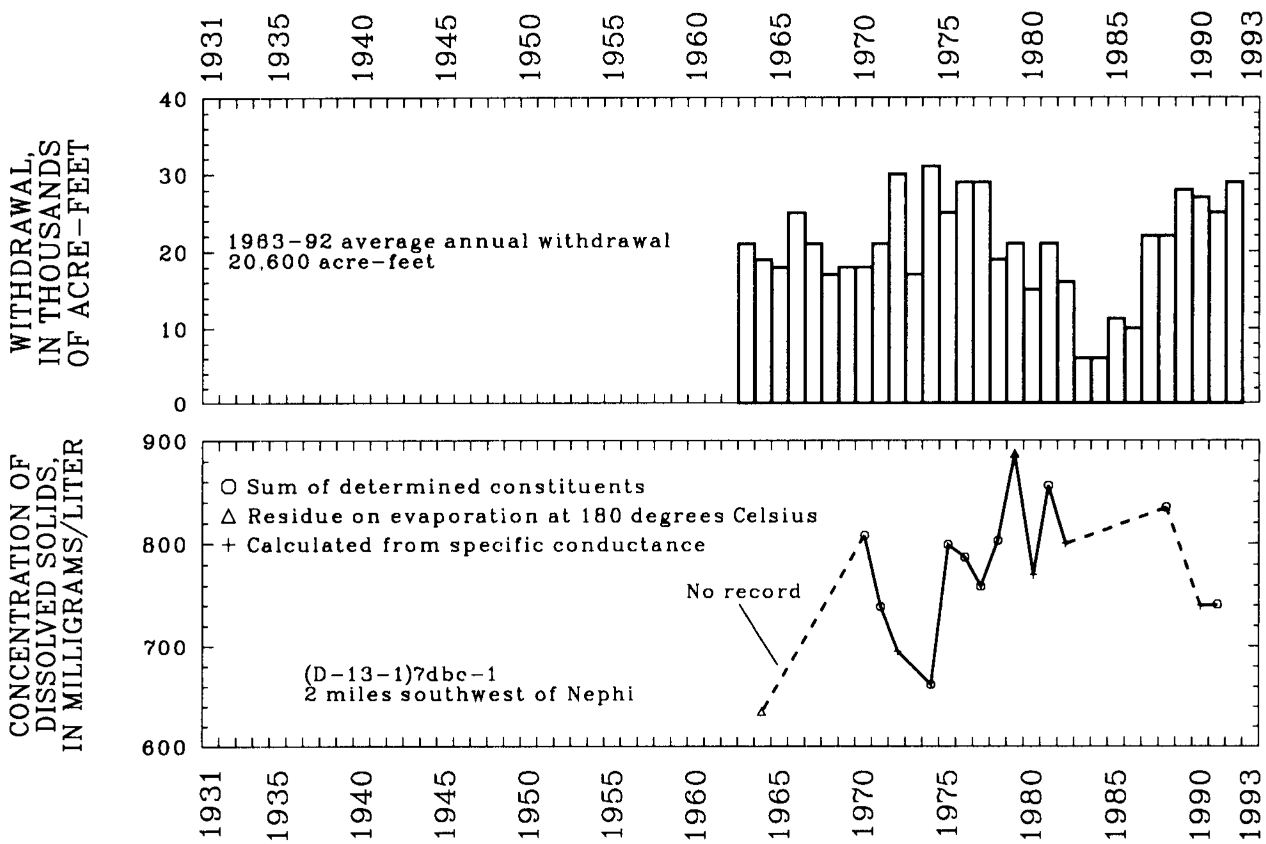

Figure 24. Relation of water levels in selected wells in Juab Valley to cumulative departure from the average annual precipitation at Nephi, to annual withdrawals from wells, and to concentration of dissolved solids in water from well (D-13-1)7dbc-1—Continued.

SEVIER DESERT

by S.J. Gerner

Withdrawal of water from wells in the Sevier Desert in 1992 was about 33,000 acre-feet. This is 1,000 acre-feet less than was reported for 1991 and about 16,000 acre-feet more than the 1982-91 average annual withdrawal (tables 2 and 3). The average annual withdrawal during 1988-92 was 27,000 acre-feet, 16,000 acre-feet more than the average for the preceding five-year period, 1983-87.

Water levels generally declined in the shallow artesian aquifer in the Sevier Desert from March 1988 to March 1993 (fig. 25). Water levels rose less than 2 feet in two wells in the southwestern part of the area. Water levels generally declined in the deep artesian aquifer from March 1988 to March 1993 (fig. 26). Declines of nearly 32 feet occurred near Oak City. The declines generally are smaller toward the west and southwest. The declines in water levels in both aquifers probably are the result of increased withdrawals during 1988-92, as compared with the preceding five-year period, 1983-87, and decreased recharge resulting from less precipitation and less streamflow during 1988-92, as compared with the preceding five-year period.

Water levels generally declined in the shallow and deep artesian aquifers from March 1963 to March 1993 (figs. 27 and 28). Water-level declines of nearly 11 feet in the shallow artesian aquifer and 22 feet in the deep artesian aquifer occurred in the Delta area. A decline in water level of about 33 feet occurred in the deep artesian aquifer near Lynndyl. The decline in water levels probably is the result of continued large withdrawals of ground water. Water levels rose in the shallow artesian aquifer in three local areas: east of Delta, east of Lynndyl, and north of Oak City. The largest rise in the shallow artesian aquifer was 3.3 feet north of Oak City. Water levels rose less than a foot in the deep artesian aquifer in a small area south of Delta. These local increases in water levels may be a result of reduced local withdrawals.

The relation of water levels in selected wells to discharge of the Sevier River near Juab, to cumulative departure from the average annual precipitation at Oak City, to annual withdrawals from wells, and to concentration of dissolved solids in water from well (C-15-4)18daa-1 is shown in figure 29. Precipitation at Oak City was 9.96 inches in 1992, 2.73 inches less than the 1935-92 average annual precipitation. Average annual precipitation for 1988-92 was 10.74 inches, 5.37 inches less than for the preceding five-year period, 1983-87.

Discharge of the Sevier River during 1992 was 121,400 acre-feet, 16,100 acre-feet more than the revised value for 1991 and 61,900 acre-feet less than the long-term average (1935-92). Average annual flow of the Sevier River during 1988-92 was 133,900 acre-feet, about 392,600 acre-feet less than for the preceding five-year period, 1983-87.

The concentration of dissolved solids in water from well (C-15-4)18daa-1, near Lynndyl, has increased from about 900 milligrams per liter in 1958 to about 1,800 milligrams per liter in 1990. This increase may be a result of recharge from unconsumed irrigation water, which contains more dissolved solids than does local ground water (Handy and others, 1969).

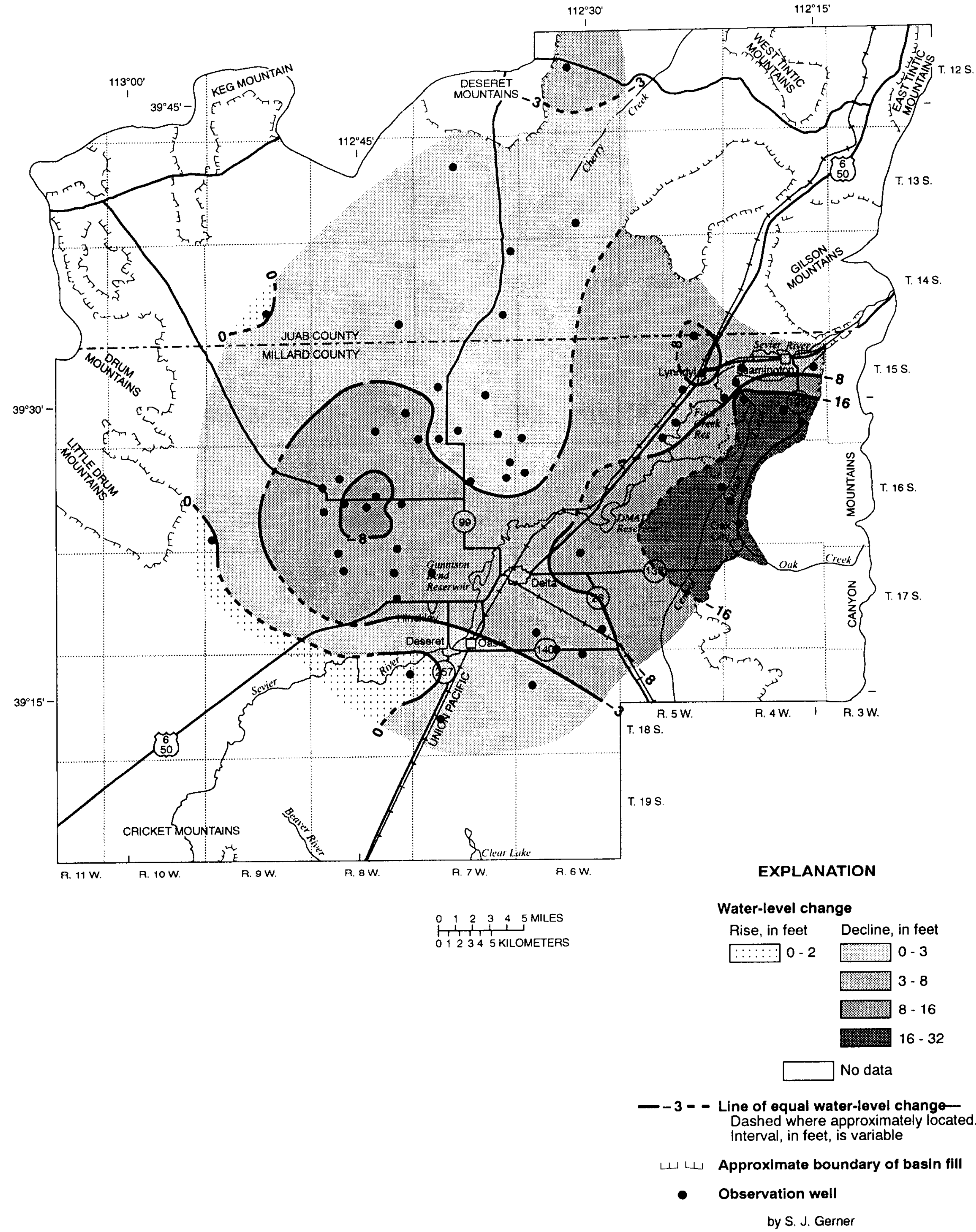

Figure 25. Map of part of the Sevier Desert showing change of water levels in the shallow artesian aquifer from March 1988 to March 1993.

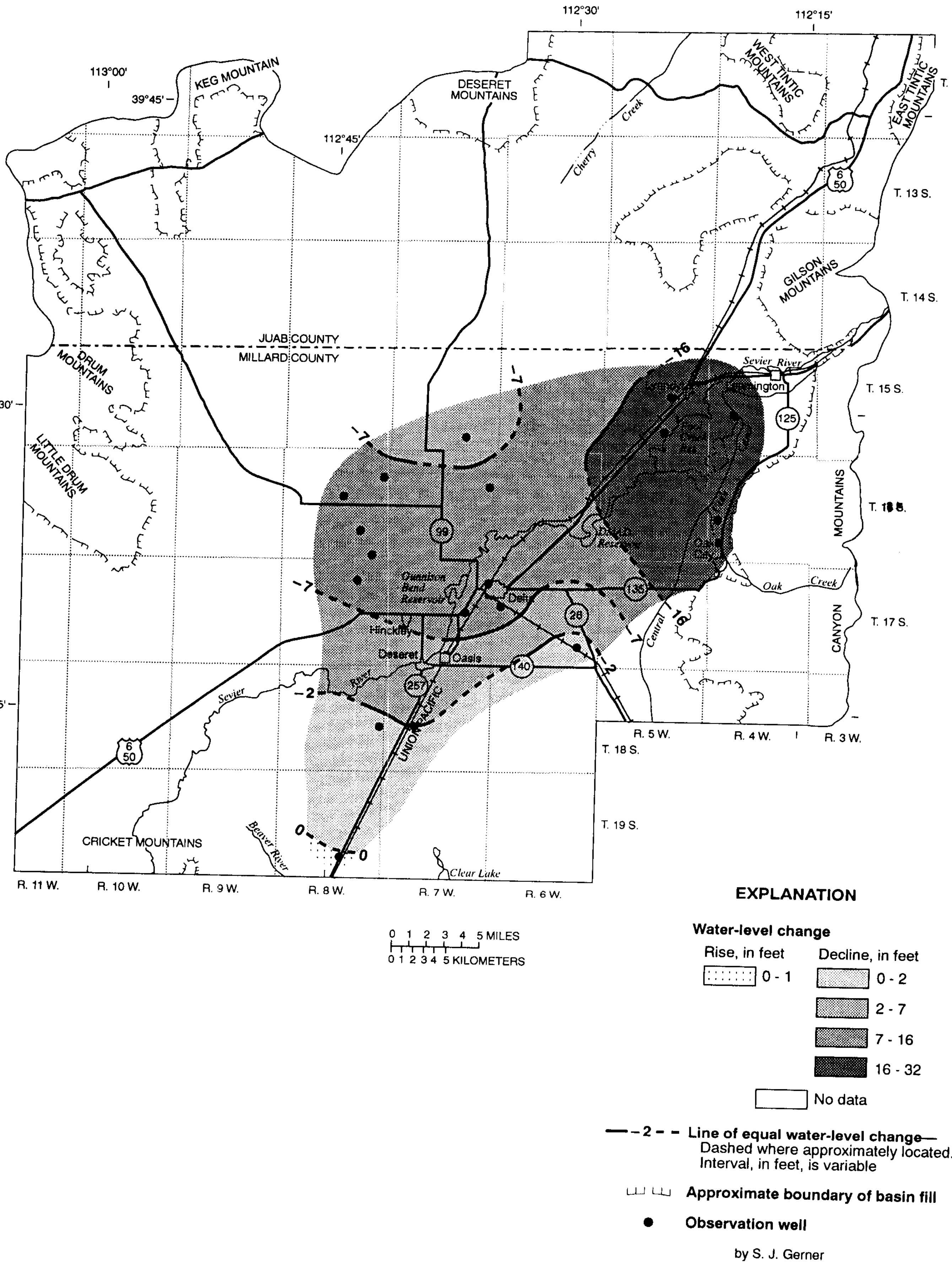

Figure 26. Map of part of the Sevier Desert showing change of water levels in the deep artesian aquifer from March 1988 to March 1993.

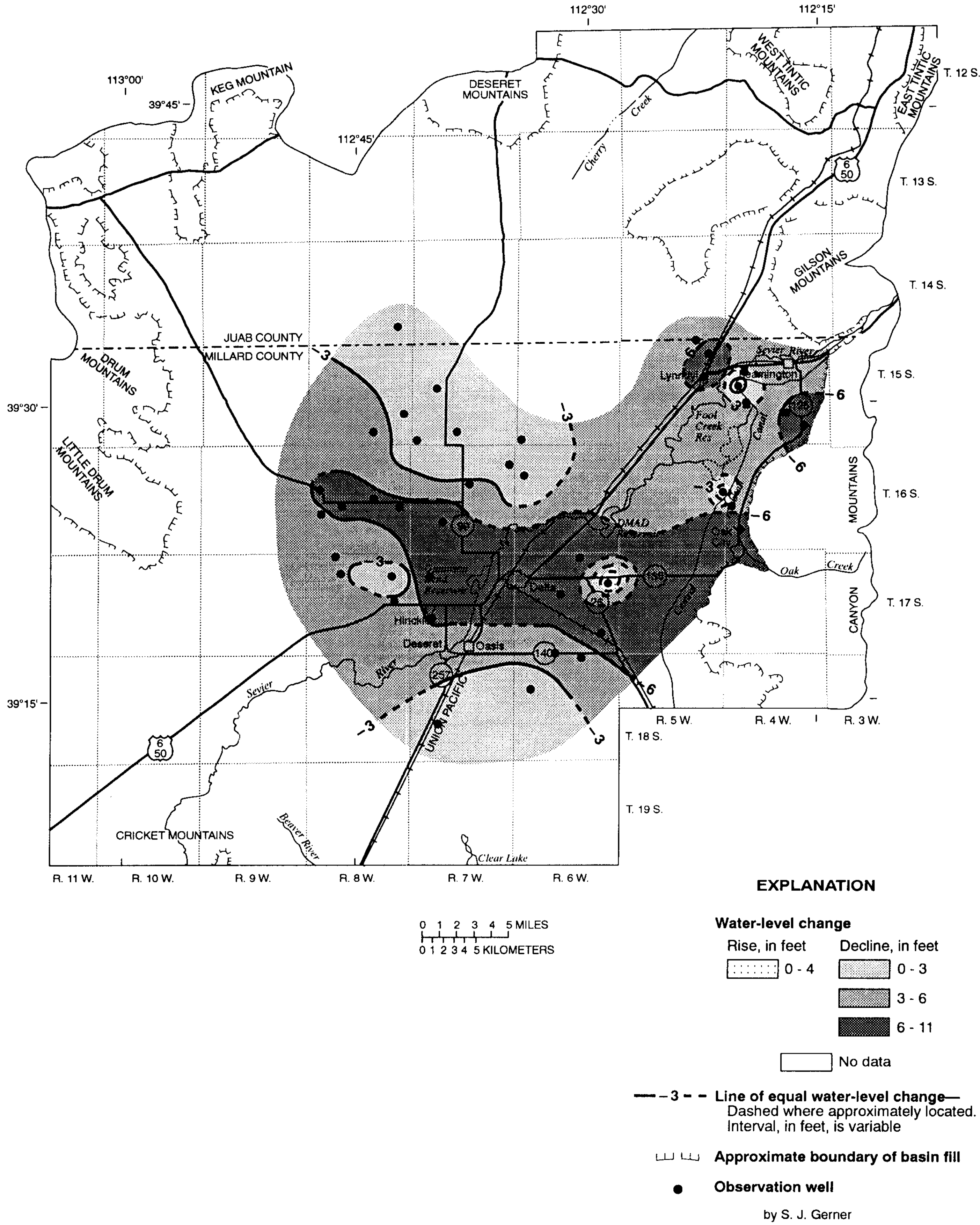

Figure 27. Map of part of the Sevier Desert showing change of water levels in the shallow artesian aquifer from March 1963 to March 1993.

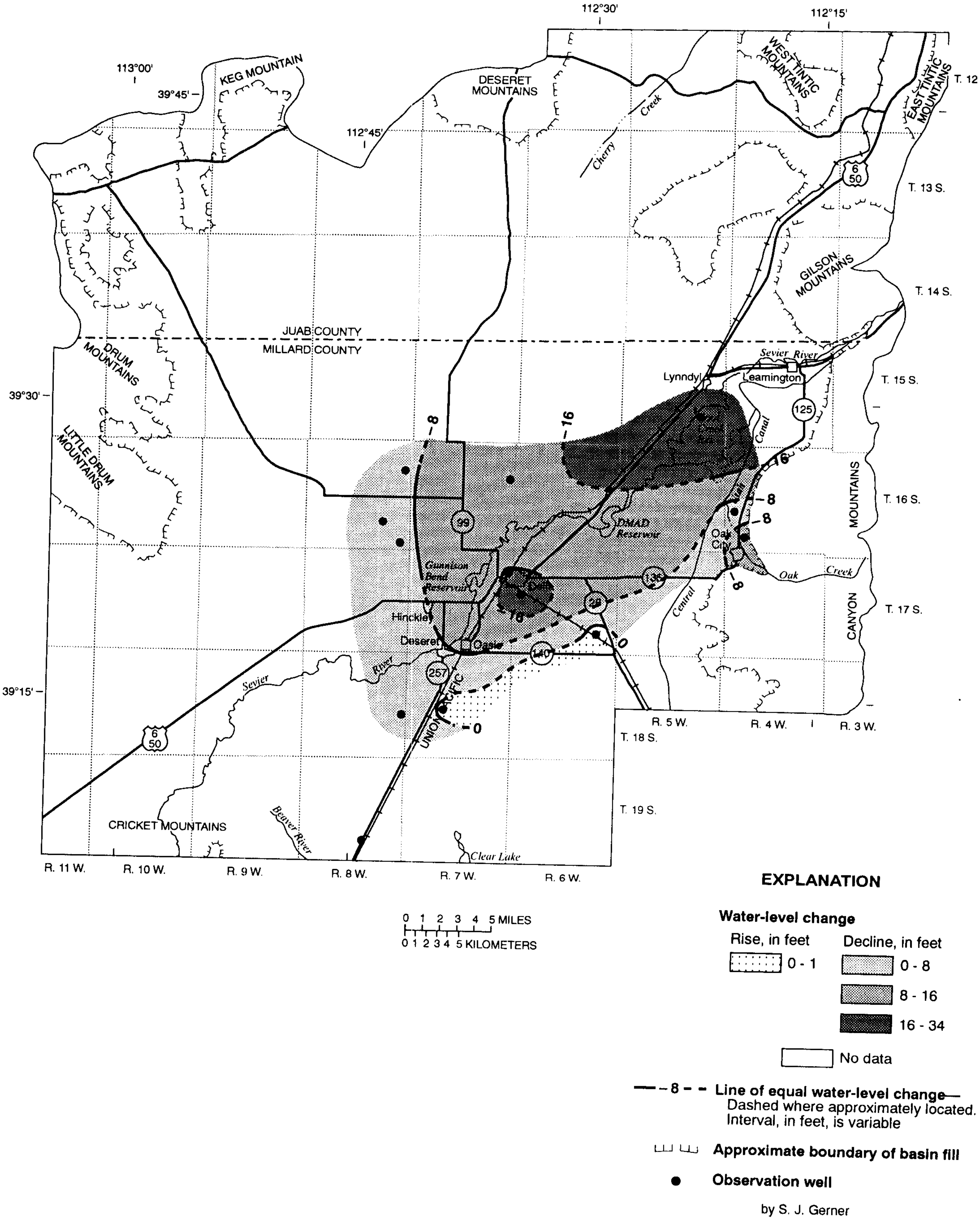

Figure 28. Map of part of the Sevier Desert showing change of water levels in the deep artesian aquifer from March 1963 to March 1993.

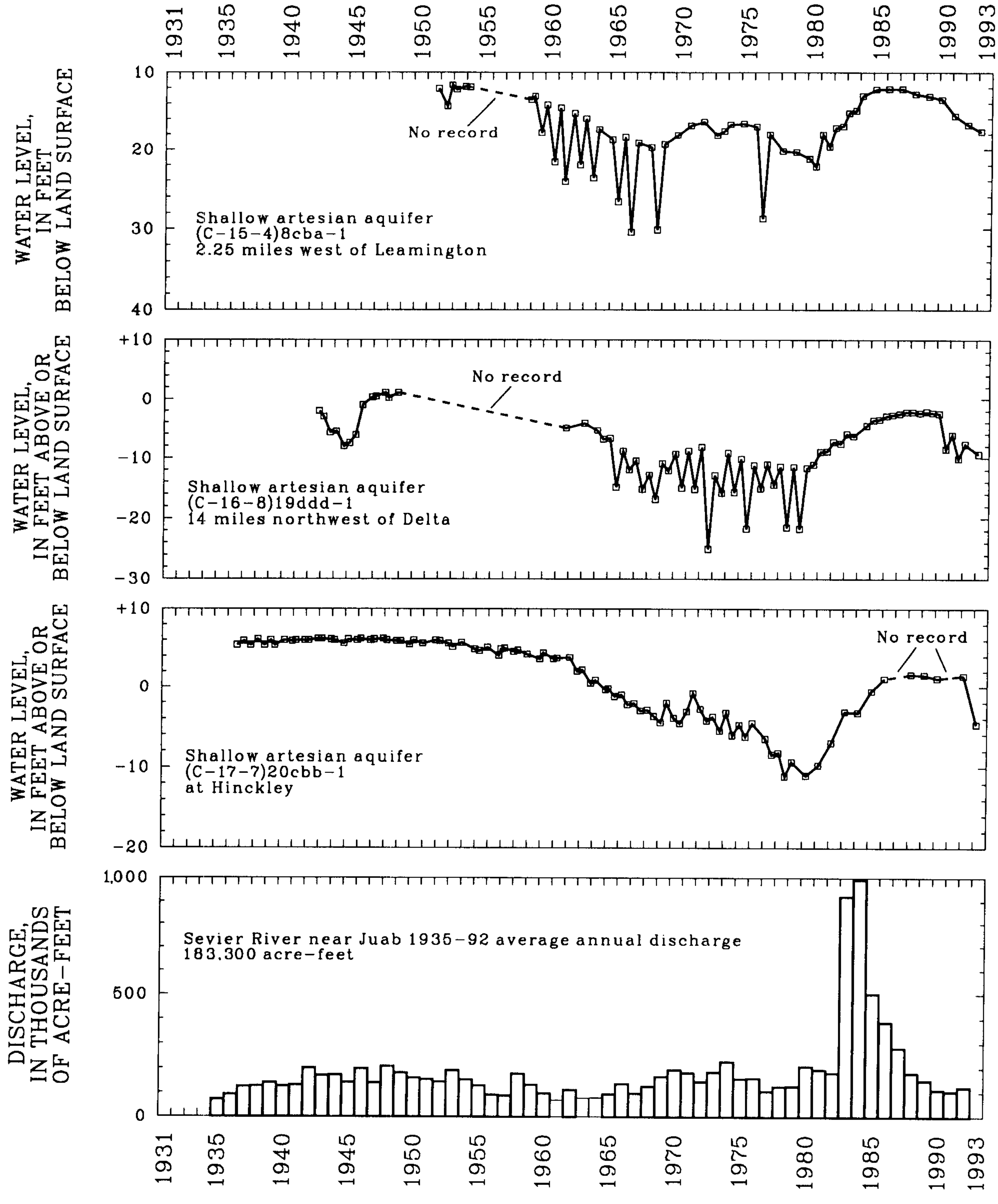

Figure 29. Relation of water levels in selected wells in the Sevier Desert to discharge of the Sevier River near Juab, to cumulative departure from the average annual precipitation at Oak City, to annual withdrawals from wells, and to concentration of dissolved solids in water from well (C-15-4)18daa-1.

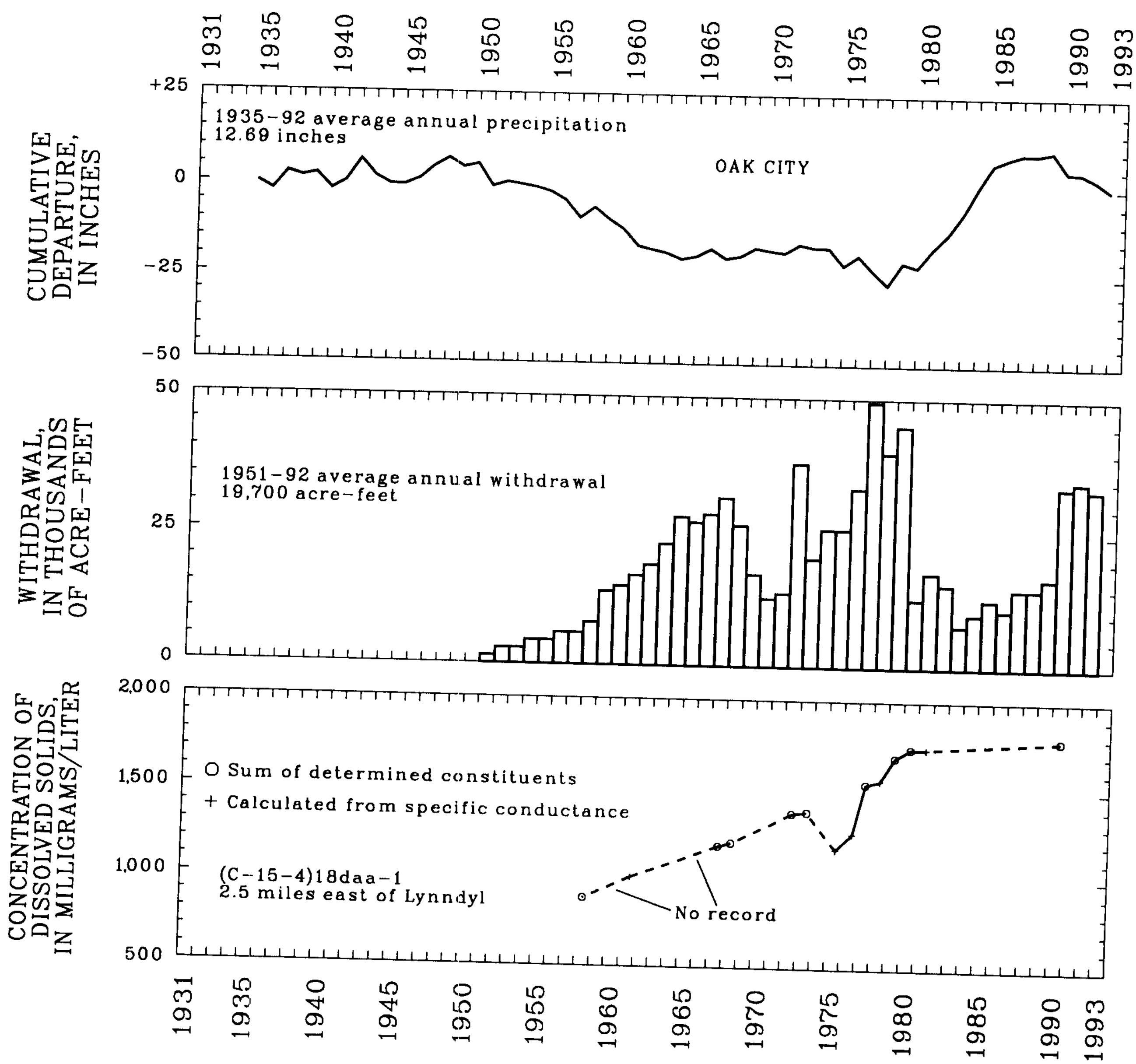

Figure 29. Relation of water levels in selected wells in the Sevier Desert to discharge of the Sevier River near Juab, to cumulative departure from the average annual precipitation at Oak City, to annual withdrawals from wells, and to concentration of dissolved solids in water from well (C-15-4)18daa-1—Continued.

CENTRAL SEVIER VALLEY

by B.A. Slaugh

Withdrawal of water from wells in the central Sevier Valley in 1992 was about 19,000 acre-feet; 1,000 acre-feet more than in 1991. The 1992 withdrawal is also 1,000 acre-feet more than the ten-year average for 1982-91 and the five-year average for 1988-92, but is 2,000 acre-feet more than the five-year average for 1983-87 (tables 2 and 3).

Water levels declined in most of the central Sevier Valley from March 1988 to March 1993 (fig. 30). The largest decline, about 22 feet, occurred south of Monroe. The decline in water levels probably is because of less precipitation, resulting in less streamflow and less recharge during 1988-92 than during 1983-87, and because of greater withdrawals for public supply. Water levels rose slightly, less than 1 foot, east of Venice and south of Richfield.

Water levels rose from March 1963 to March 1993 in most parts of the central Sevier Valley for which water-level change data are available (fig. 31), with the greatest rise, 9.4 feet, recorded at a well just west of Kingston. Water levels southeast of Richfield (-1.16 feet) and near Axtel (-2.33 feet) decreased during this period.

The relation of water levels in selected wells to discharge of the Sevier River at Hatch, to cumulative departure from the average annual precipitation at Salina, to annual withdrawals from wells, and to concentration of dissolved solids in water from well (C-23-2)15dcb-4 is shown in figure 32. Discharge of the Sevier River at Hatch in 1992 was about 55,000 acre-feet, about 12,900 acre-feet more than the 42,100 acre-feet for 1991 and about 22,900 acre-feet less than the 1940-92 average annual discharge. The average annual discharge during 1988-92 was about 51,700 acre-feet, approximately 54,500 acre-feet less than the 1983-87 annual average discharge.

Precipitation at Salina was 8.00 inches in 1992, which was 1.94 inches less than the 1935-92 average annual precipitation. The average annual precipitation for 1988-92 was 8.10 inches, which was 2.85 inches less than the average for the preceding five-year period, 1983-87. The concentration of dissolved solids in water from well (C-23-2)15dcb-4 has ranged from about 330 milligrams per liter to about 600 milligrams per liter with no apparent long-term trend.

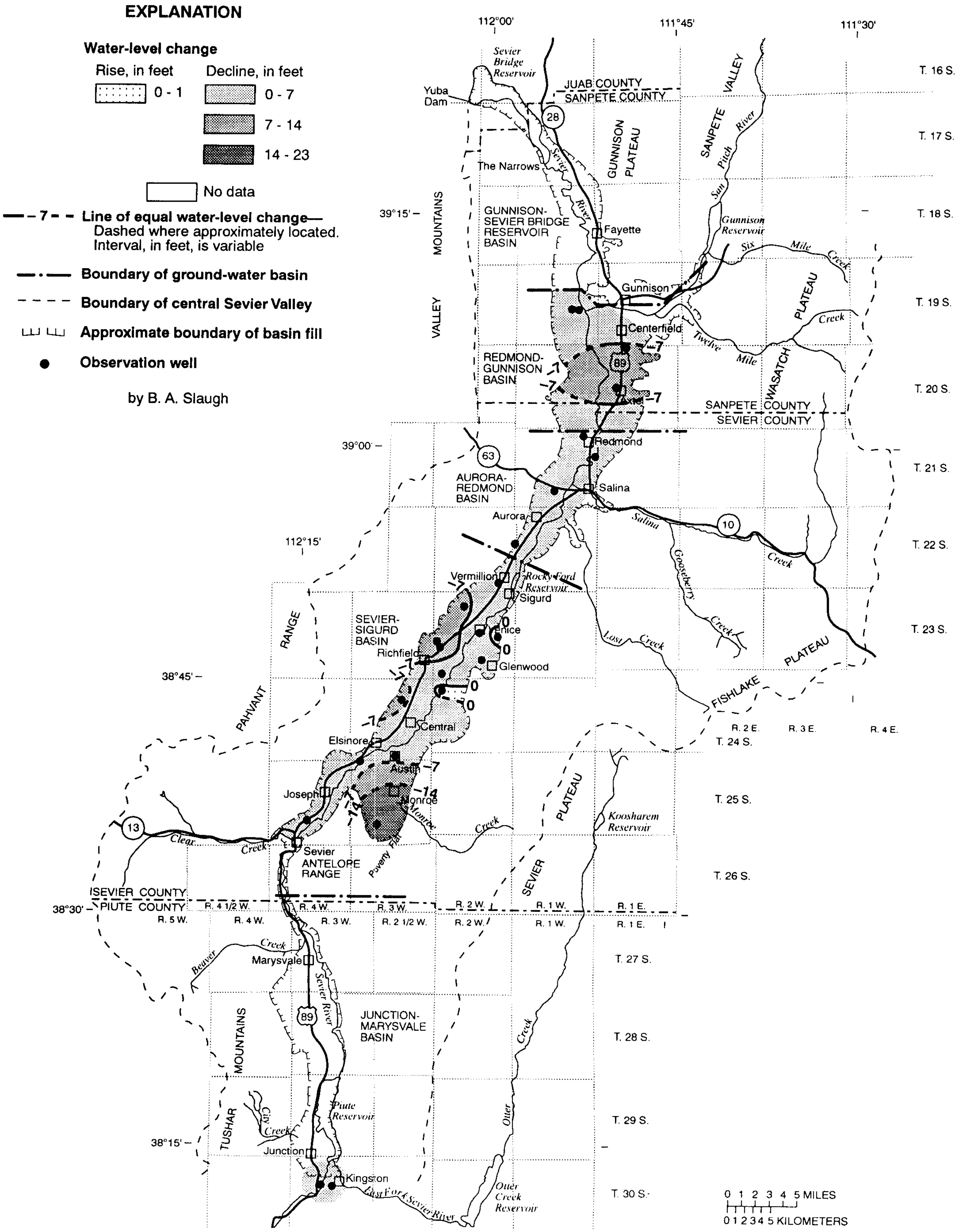

Figure 30. Map of the central Sevier Valley showing change of water levels from March 1988 to March 1993.

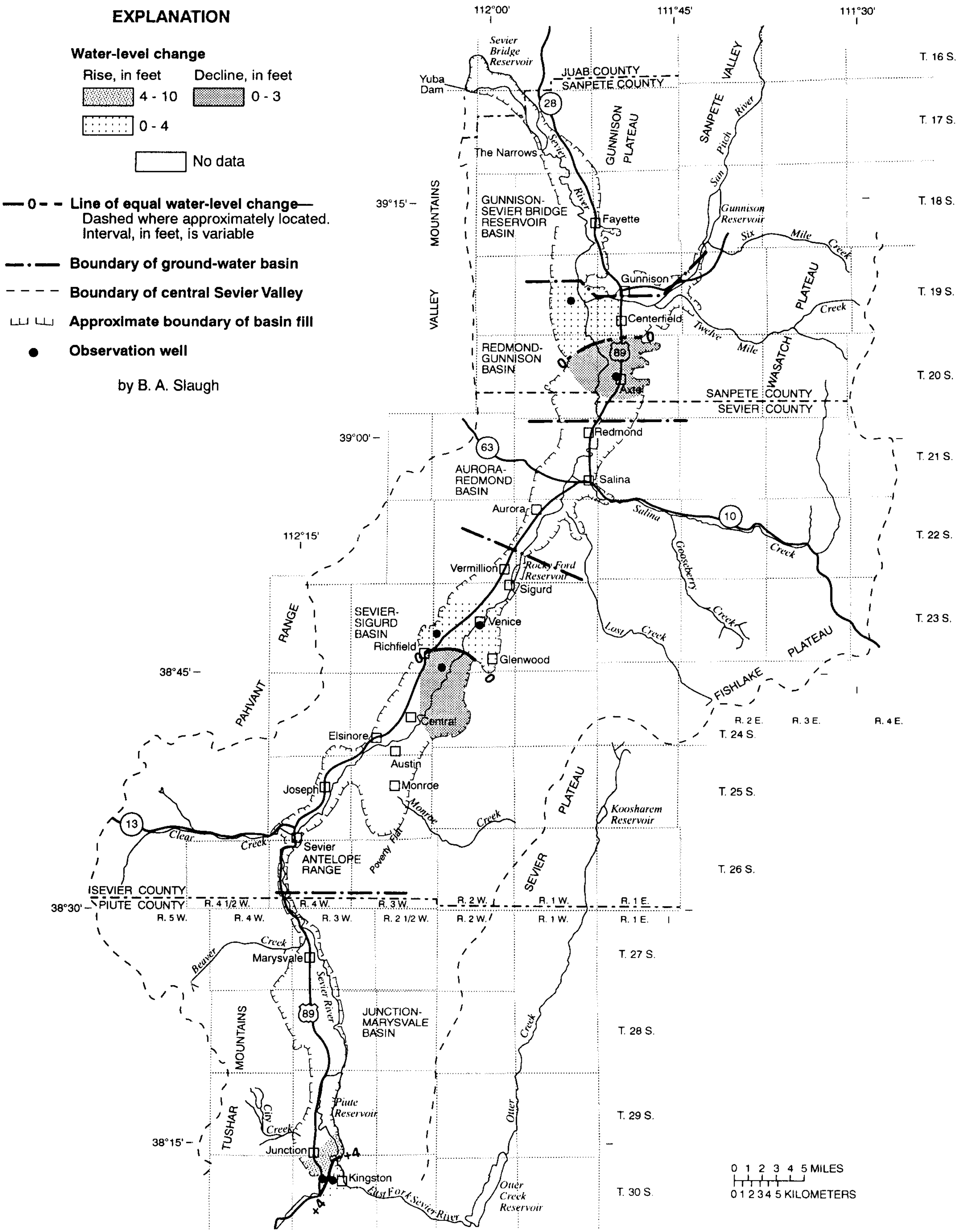

Figure 31. Map of the central Sevier Valley showing change of water levels from March 1963 to March 1993.

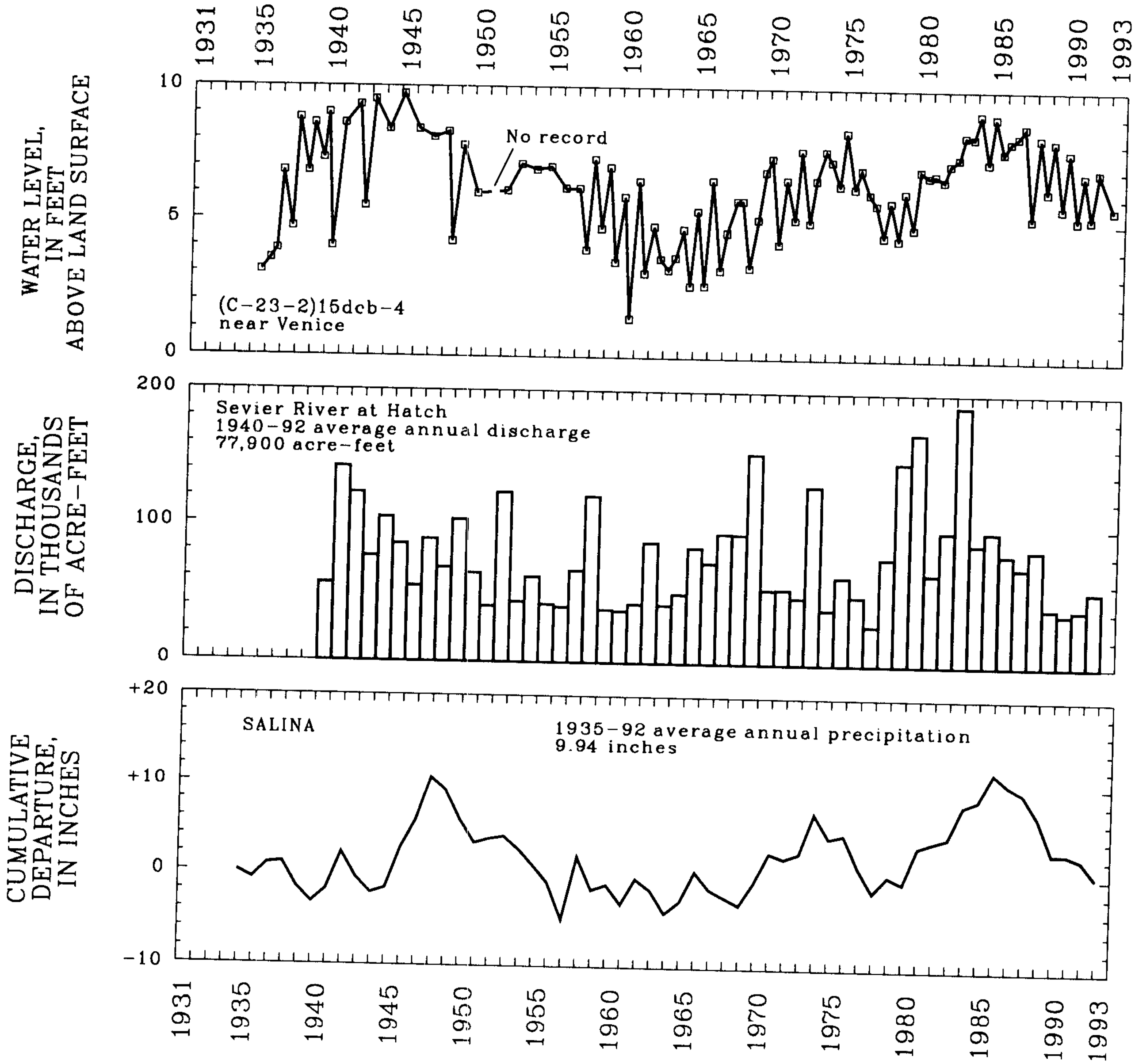

Figure 32. Relation of water levels in selected wells in central Sevier Valley to discharge of the Sevier River at Hatch, to cumulative departure from the average annual precipitation at Salina, to annual withdrawals from wells, and to concentration of dissolved solids in water from well (C-23-2)15dcb-4.

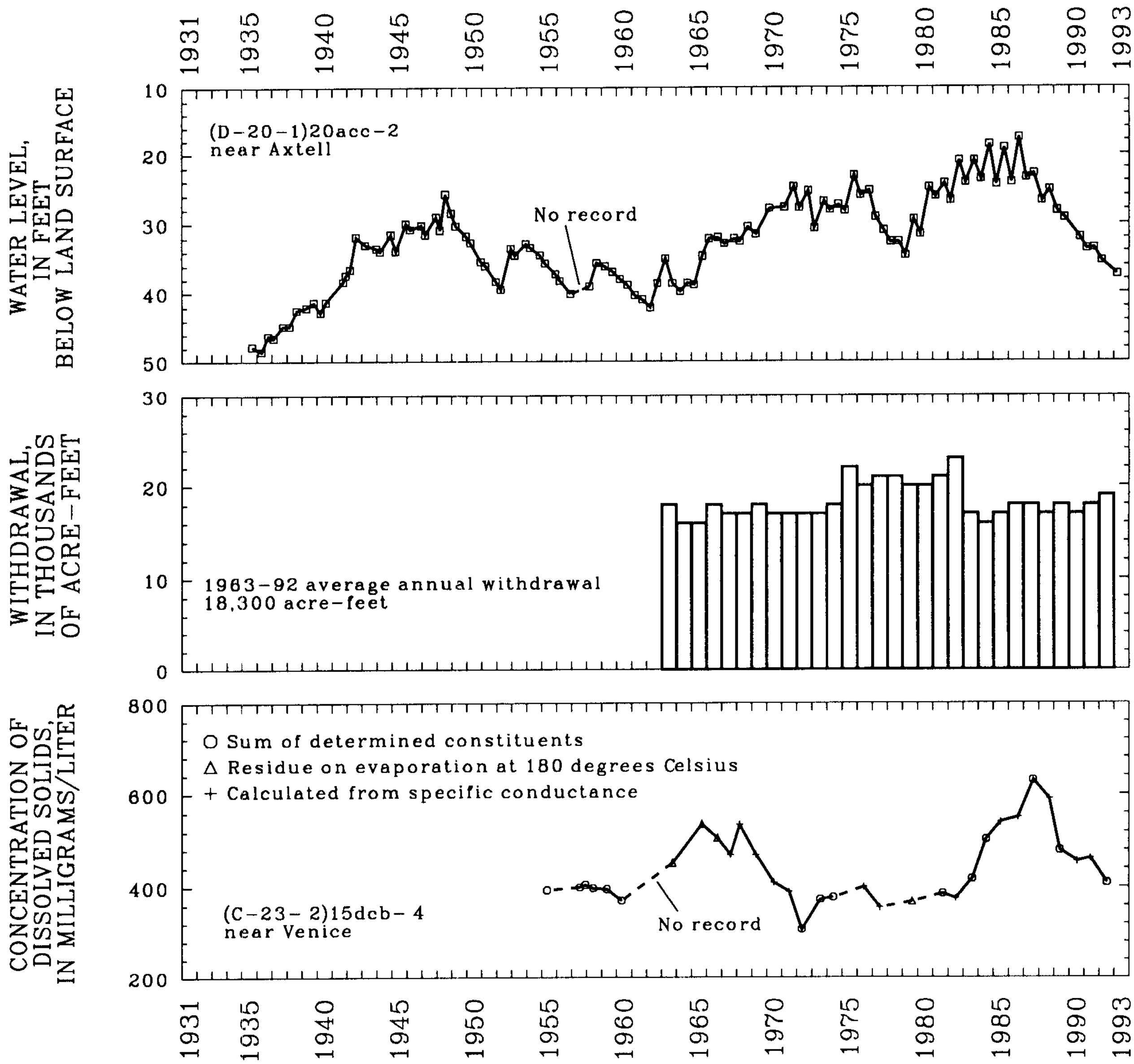

Figure 32. Relation of water levels in selected wells in central Sevier Valley to discharge of the Sevier River at Hatch, to cumulative departure from the average annual precipitation at Salina, to annual withdrawals from wells, and to concentration of dissolved solids in water from well (C-23-2)15dcb-4—Continued.

PAHVANT VALLEY

by R.L. Swenson

Withdrawal of water from wells in Pahvant Valley in 1992 was about 86,000 acre-feet. This is 12,000 acre-feet more than was reported in 1991, and 20,000 acre-feet more than the average annual withdrawal for 1982-91 (tables 2 and 3). The increase in withdrawals from 1991 to 1992 resulted from a substantial increase in withdrawal for irrigation. Irrigation withdrawal for 1992 was 85,400 acre-feet, an increase of 12,500 acre-feet over the withdrawal reported in 1991. Withdrawals have generally increased over the last 10 years from an annual average of 54,000 acre-feet during 1983-87, to an annual average of 80,000 acre-feet for the following five-year period, 1988-92.

Water levels declined in most of Pahvant Valley from March 1988 to March 1993 (fig. 33). The maximum decline of almost 52 feet occurred just west of Holden. Declines of about 30 feet or greater also occurred in areas along the eastern part of the valley just west of Fillmore, between Meadow and Kanosh, and in a small area in the southernmost part of the valley west of Kanosh. Declines in water levels probably resulted from increased withdrawals for irrigation and decreased recharge because of less precipitation during 1988-92 as compared with 1983-87.

Water-level rises occurred in local areas along the extreme western and southwestern sections of the valley and in a small area around Holden. The greatest rise of about 8 feet occurred near Holden. Rises may be a result of decreased local withdrawals.

Water-level changes from March 1963 to March 1993 are shown in figure 34. Water levels generally declined in the northern and northwestern parts of the valley and rose in the southern and eastern parts. The declines probably are related to long-term, large withdrawals of ground water. A maximum decline of almost 40 feet occurred southeast of McCornick. A small area of decline was also observed northeast of Hatton in the southeastern part of the valley. The rises probably are related to precipitation during 1963-92, and particularly during 1980-86, which was greater than the long-term average, and probably resulted in greater streamflow and recharge. Water-level rises greater than 15 feet occurred in areas near Holden, Meadow, and west of Kanosh, with a maximum rise of nearly 22 feet measured in a well about 3 miles north of Meadow.

The relation of water levels in selected wells to cumulative departure from the average annual precipitation at Fillmore and to annual withdrawals from wells is shown in figure 35. Precipitation at Fillmore during 1992 was 12.75 inches, which is 2.15 inches less than the average annual precipitation for 1931-92. The average annual precipitation during 1988-92, 13.45 inches, was 6.04 inches less than the annual average for the preceding five-year period, 1983-87. The increases in recharge (as well as small average withdrawals from wells during 1983-86) (fig. 35) is indicated by general rises in water levels in all selected wells during 1982-86.

The concentrations of dissolved solids in water from wells near Flowell and west of Kanosh are shown in figure 36. The sample from the Flowell district showed a slight increase in concentration of dissolved solids for 1992 compared with 1991. No data have been available for the well in the Kanosh district since 1990. Water from both wells shows a general increase in concentration since the 1950's, although the lower concentrations in water from both wells since the late 1970's may be related to increased recharge associated with greater-than-average precipitation during 1980-86.

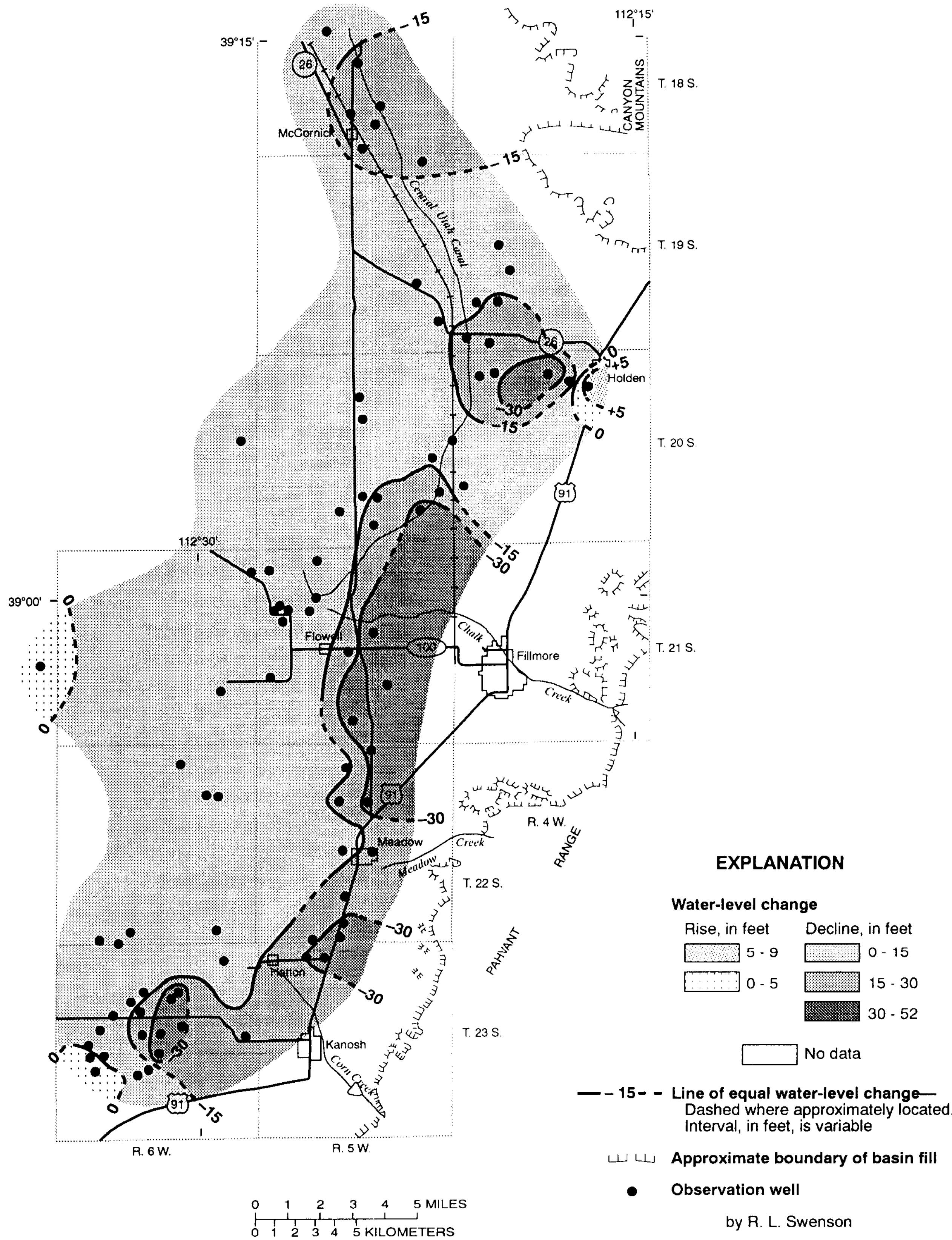

Figure 33. Map of Pahvant Valley showing change of water levels from March 1988 to March 1993.

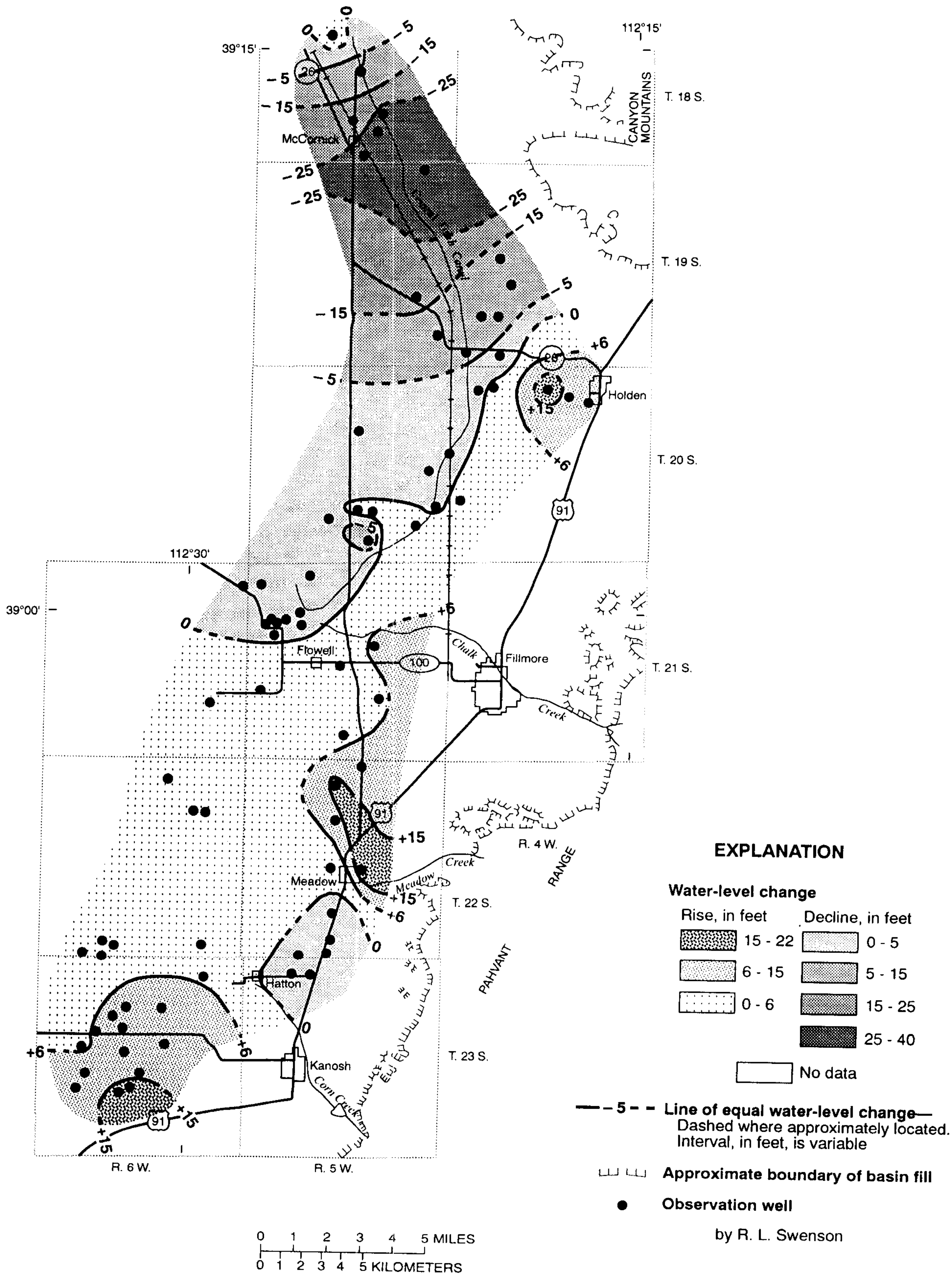

Figure 34. Map of Pahvant Valley showing change of water levels from March 1963 to March 1993.

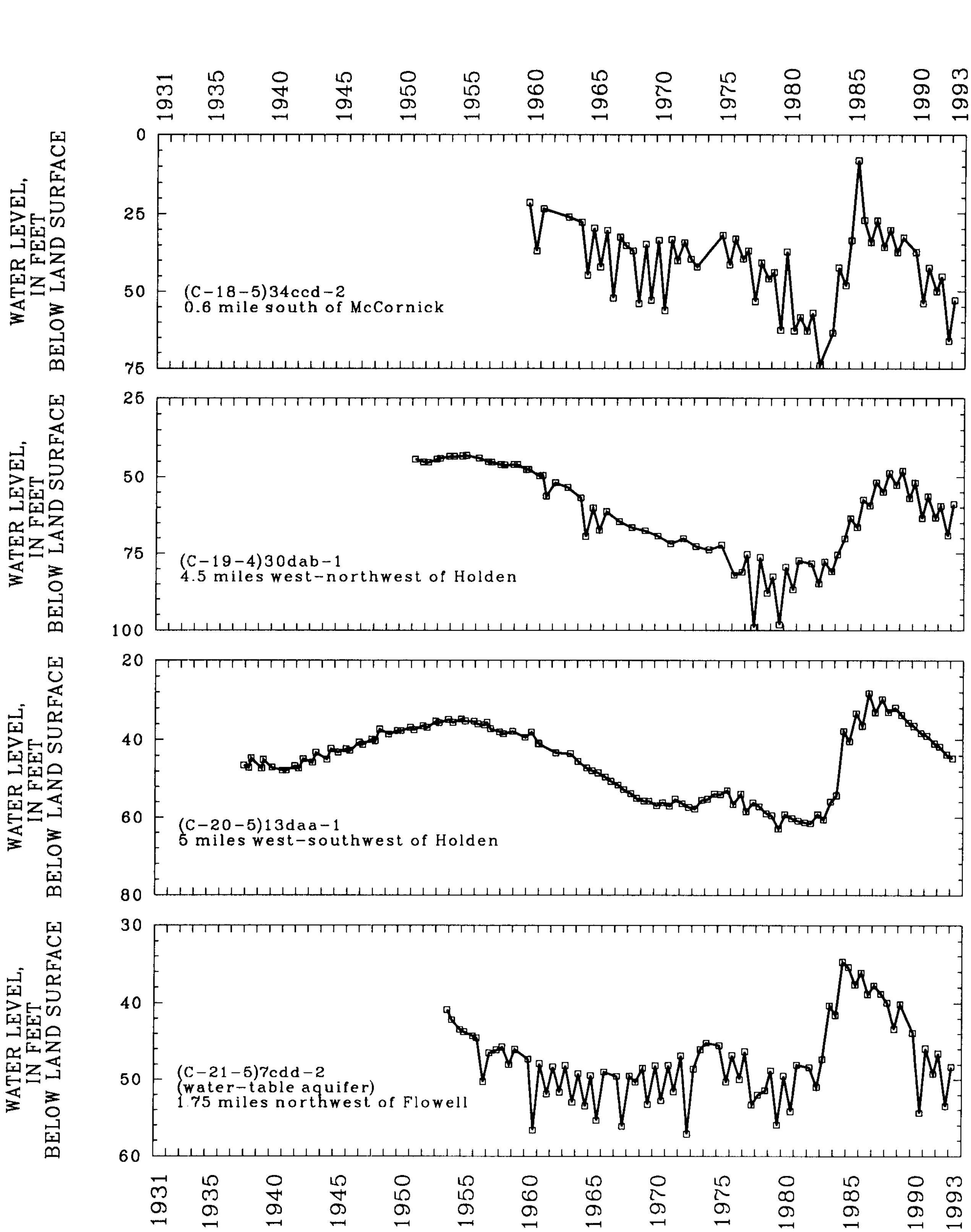

Figure 35. Relation of water levels in selected wells in Pahvant Valley to cumulative departure from the average annual precipitation at Fillmore and to annual withdrawals from wells.

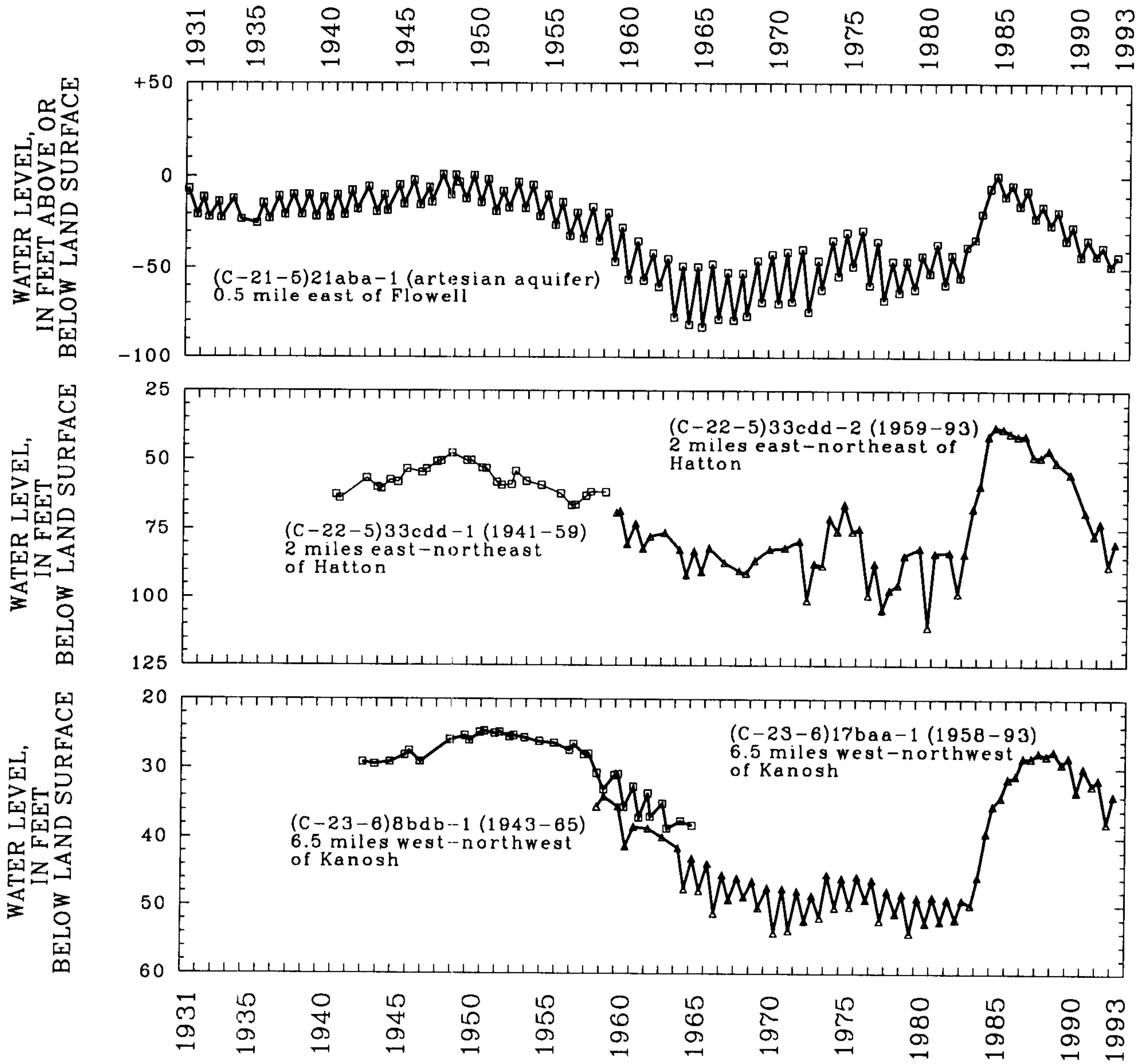

Figure 35. Relation of water levels in selected wells in Pahvant Valley to cumulative departure from the average annual precipitation at Fillmore and to annual withdrawals from wells—Continued.

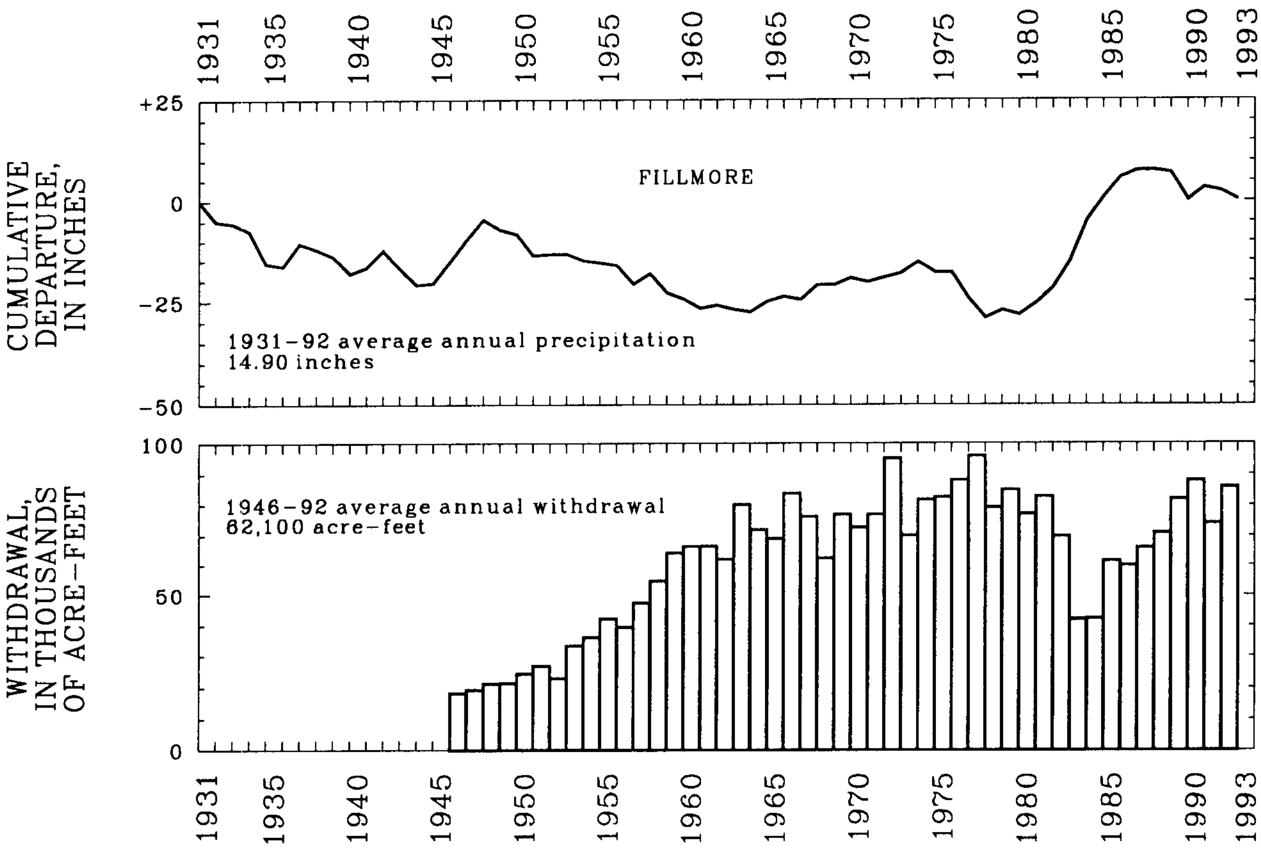

Figure 35. Relation of water levels in selected wells in Pahvant Valley to cumulative departure from the average annual precipitation at Fillmore and to annual withdrawals from wells—Continued.

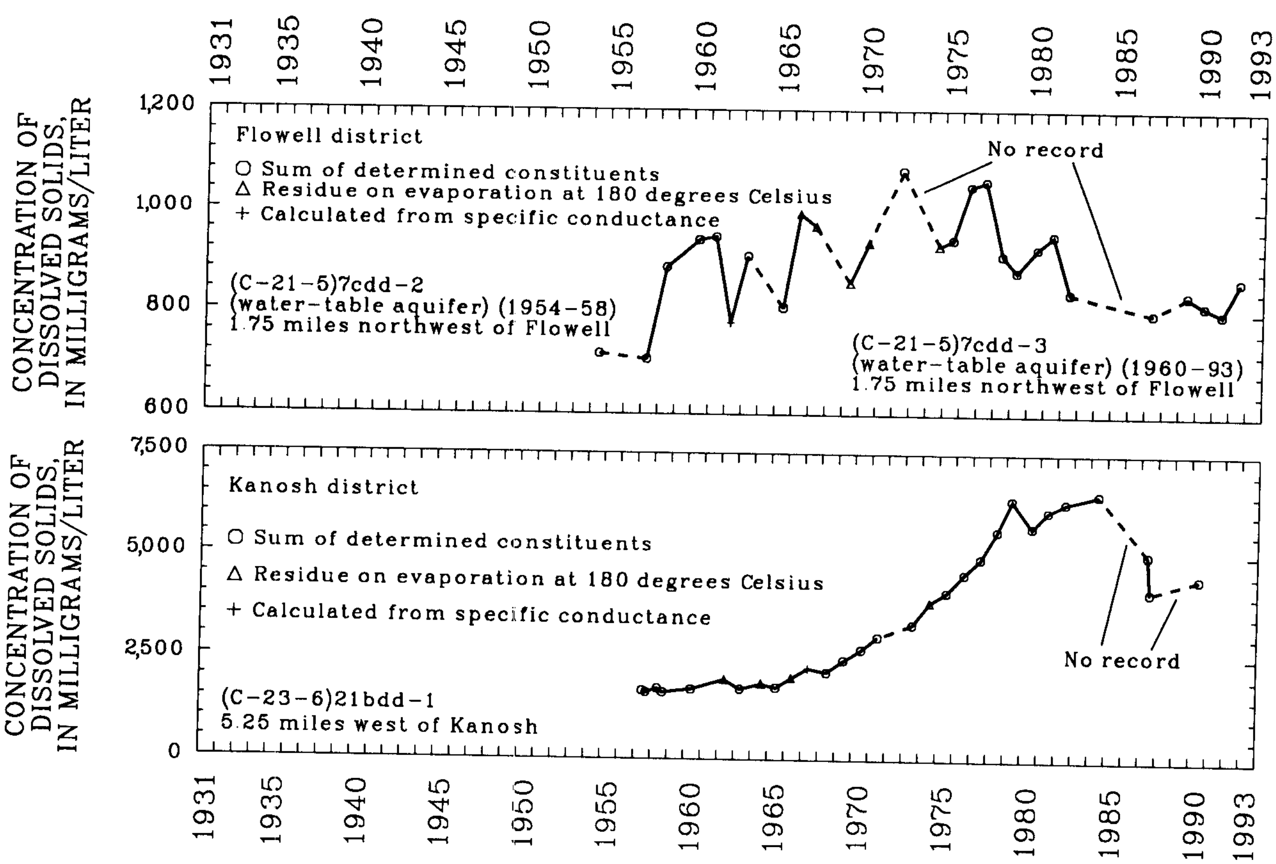

Figure 36. Concentration of dissolved solids in water from selected wells in Pahvant Valley.

CEDAR VALLEY, IRON COUNTY

by J.H. Howells

Withdrawal of water from wells in Cedar Valley, Iron County, in 1992 was about 34,000 acre-feet, which is the same quantity that was reported for 1991 and 10,000 acre-feet more than the average annual withdrawal for 1982-91 (tables 2 and 3). Average annual withdrawal during 1988-92 was about 29,000 acre-feet, which is 8,000 acre-feet more than during the previous five-year period, 1983-87.

Ground-water levels declined from March 1988 to March 1993 in most of Cedar Valley except in the extreme northeastern part, where levels rose slightly (fig. 37). The largest decline, 26.6 feet, occurred northwest of Cedar City. The declines probably are the result of increased withdrawals for irrigation and decreased recharge because of less precipitation and streamflow during 1988-92, as compared with the preceding five-year period, 1983-87. Discharge of Coal Creek during 1988-92, was about 48 percent of the discharge during 1983-87.

Ground-water levels declined from March 1963 to March 1993 in most of Cedar Valley (fig. 38). The maximum decline, 19.2 feet, was measured in a well north of Enoch. The decline in water levels probably resulted from increased ground-water withdrawals especially during periods of below-average precipitation and streamflow. Prior to 1963, annual withdrawals of ground water probably were less than 20,000 acre-feet; during 1963-92, withdrawals were more than 20,000 acre-feet in 28 of the 30 years. Ground-water levels rose in the central and southern parts of the valley, probably because of a shift in the location of withdrawals for irrigation.

The relation of water levels in wells (C-35-11)33aac-1 and (C-37-12)34abb-1 to cumulative departure from the average annual precipitation at Cedar City FAA Airport, to discharge of Coal Creek near Cedar City, to annual withdrawals of water from wells in Cedar Valley, and to concentration of dissolved solids in water from well (C-37-12)23acb-2, is shown in figure 39. Precipitation at Cedar City FAA Airport in 1992 was 11.53 inches, which is 1.71 inches more than precipitation for 1991 and 0.78 inch more than the average annual precipitation for 1951-92. Average annual precipitation for 1988-92 was 10.02 inches, 3.41 inches less than the average annual precipitation in the previous five-year period, 1983-87.

Discharge of Coal Creek was about 17,760 acre-feet in 1992, approximately 3,000 acre-feet more than the revised value for 1991, and about 5,800 acre-feet less than the average annual discharge during 1936, 1939-92. The average annual discharge of Coal Creek during 1988-92 was about 16,300 acre-feet, approximately 18,000 acre-feet less than the average annual discharge for the previous five-year period, 1983-87. The concentration of dissolved solids in water from well (C-37-12)23acb-2 declined to the lowest level since 1969.

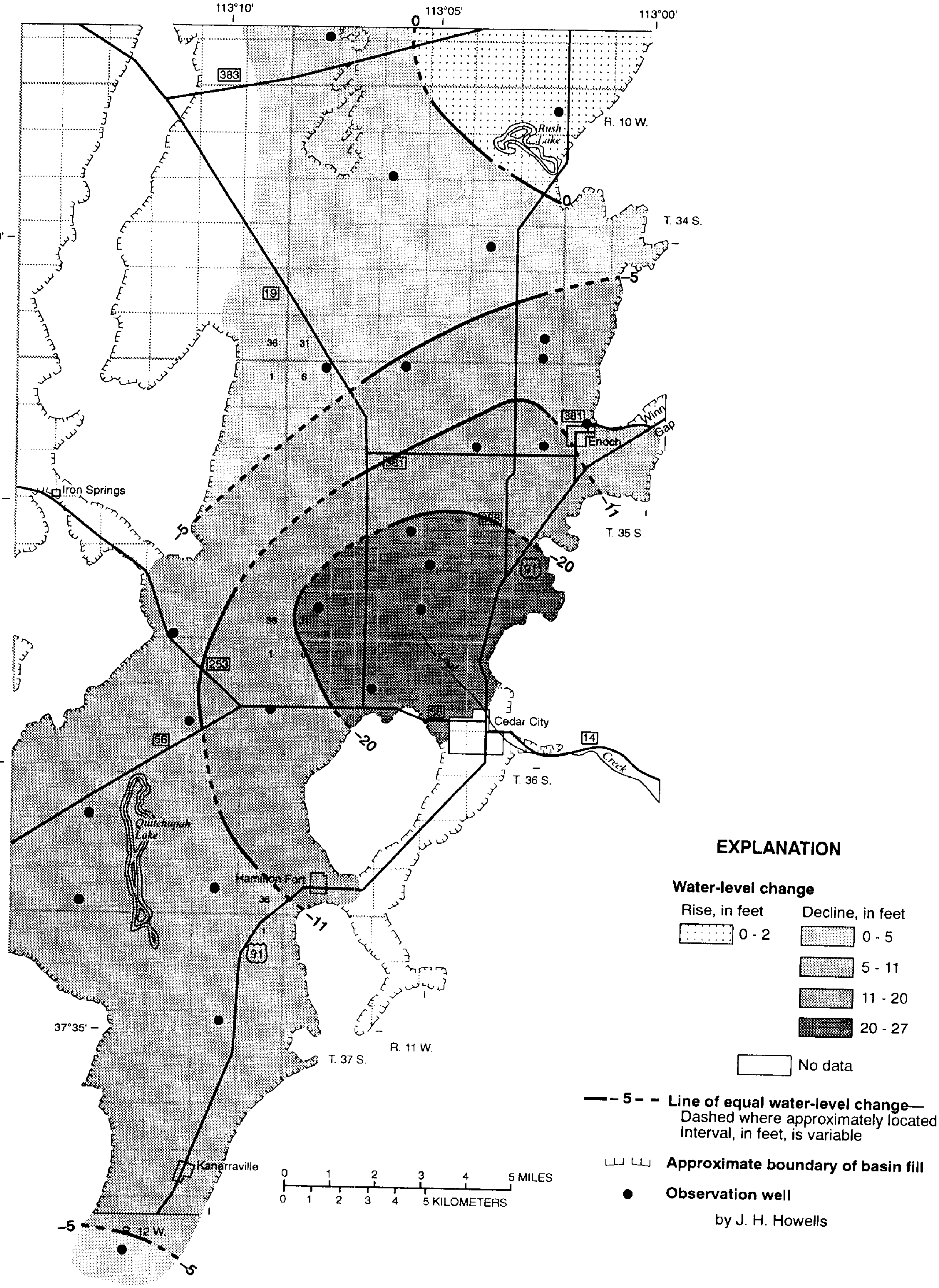

Figure 37. Map of Cedar Valley, Iron County, showing change of water levels from March 1988 to March 1993.

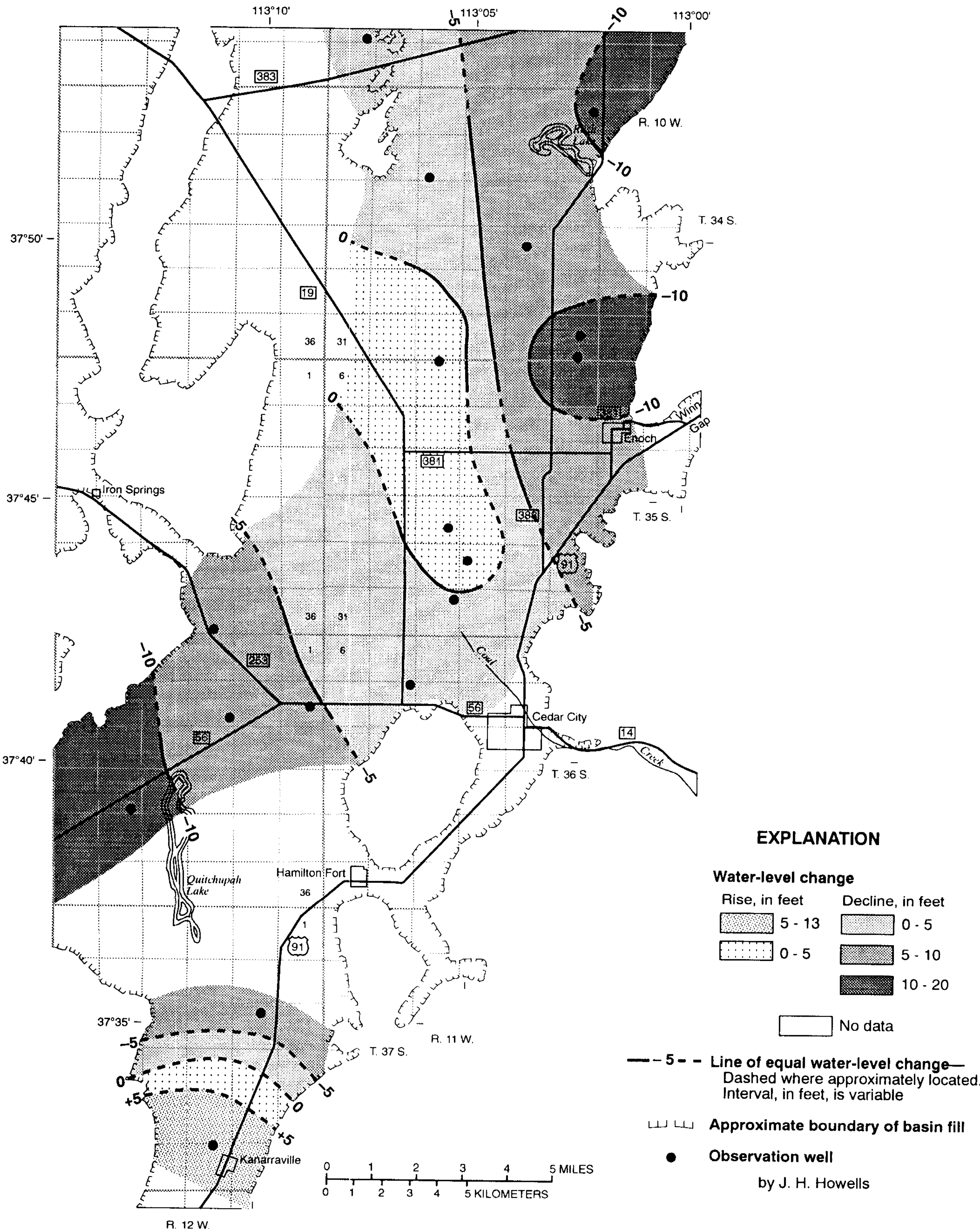

Figure 38. Map of Cedar Valley, Iron County, showing change of water levels from March 1963 to March 1993.

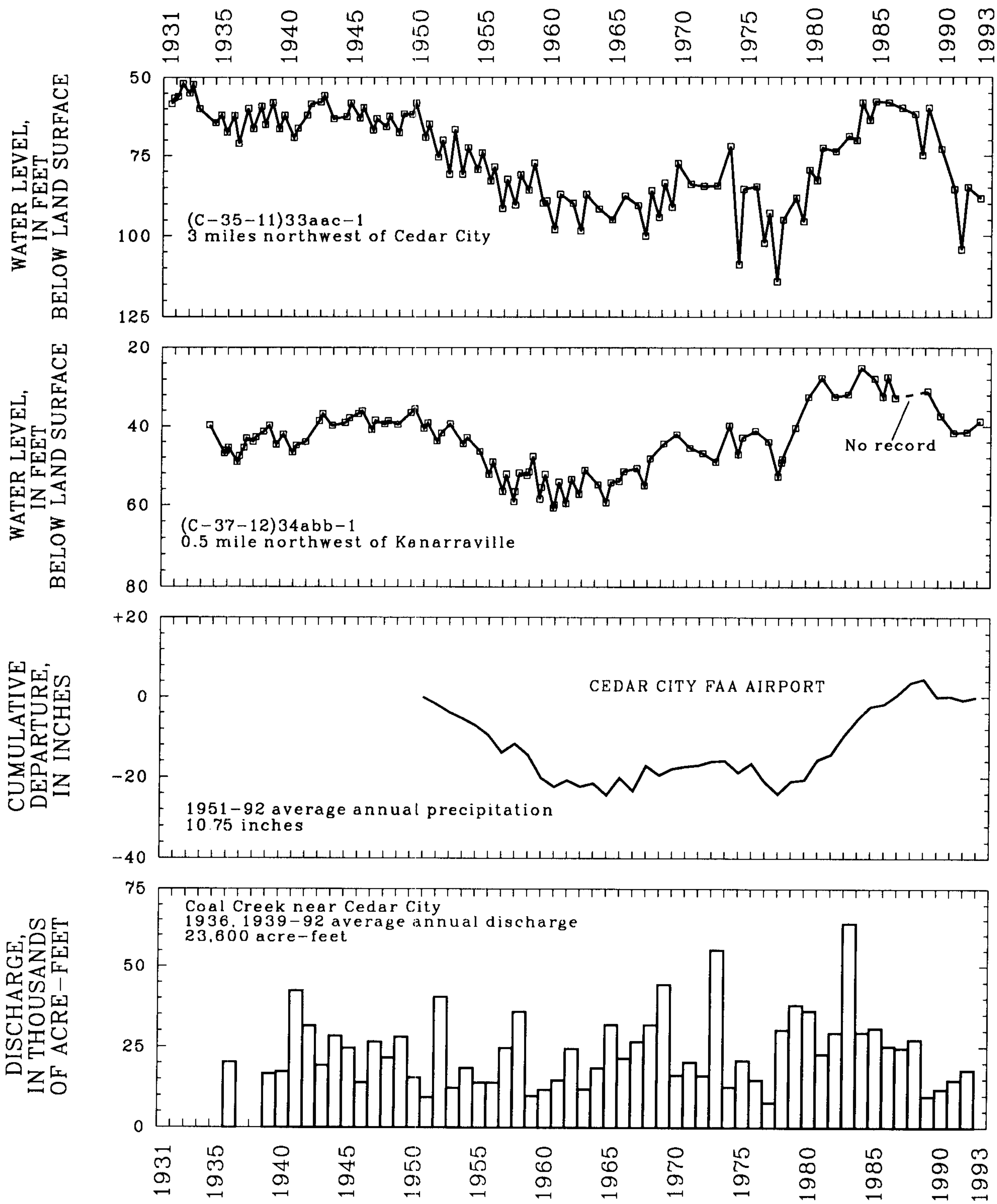

Figure 39. Relation of water levels in selected wells in Cedar Valley, Iron County, to cumulative departure from the average annual precipitation at the Cedar City FAA Airport, to discharge of Coal Creek near Cedar City, to annual withdrawals from wells, and to concentration of dissolved solids in water from well (C-37-12)23acb-2.

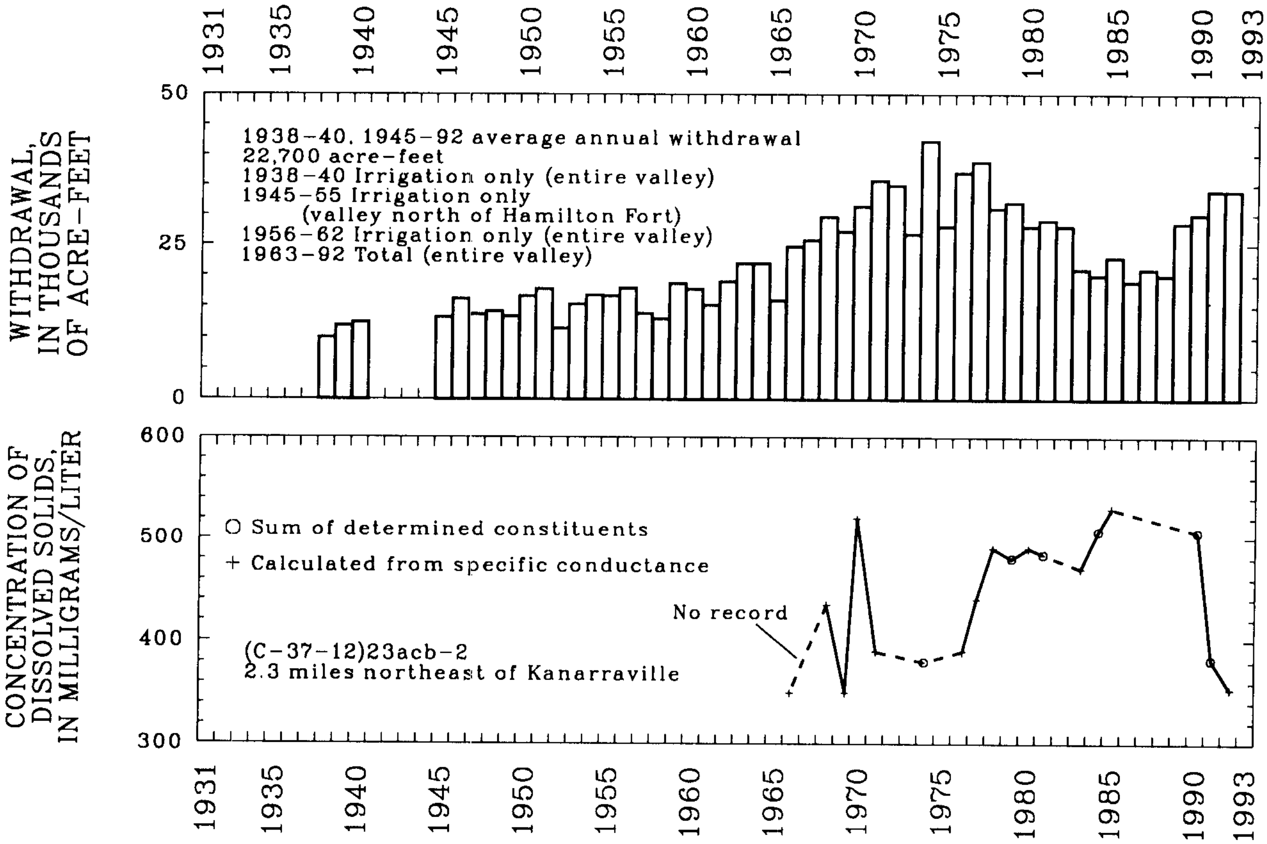

Figure 39. Relation of water levels in selected wells in Cedar Valley, Iron County, to cumulative departure from the average annual precipitation at the Cedar City FAA Airport, to discharge of Coal Creek near Cedar City, to annual withdrawals from wells, and to concentration of dissolved solids in water from well (C-37-12)23acb-2—Continued.

PAROWAN VALLEY

by J.H. Howells

Withdrawal of water from wells in Parowan Valley was about 31,000 acre-feet in 1992. This was about 1,000 acre-feet less than in 1991 and 6,000 acre-feet more than the average annual withdrawal for 1982-91 (tables 2 and 3). The average annual withdrawal for 1988-92 was about 29,000 acre-feet, 6,000 acre-feet more than the average annual withdrawal for the preceding five-year period, 1983-87. The lower withdrawal in 1992 as compared with 1991 was because of decreased withdrawals for irrigation.

Water levels declined from March 1988 to March 1993 in all parts of Parowan Valley (fig. 40) for which data are available. The largest declines, from 25 to about 45 feet, occurred in areas northwest of Parowan and northeast of Paragonah. The decline in water levels probably is the result of greater withdrawals and less recharge because of less precipitation during 1988-92 as compared with the preceding five-year period, 1983-87.

Water levels declined from March 1963 to March 1993 in all parts of Parowan Valley (fig. 41) for which data are available. The largest decline, almost 45 feet, occurred northwest of Parowan. The decline in water levels probably is because of increased withdrawals for irrigation. Prior to 1963, annual withdrawals were less than about 16,000 acre-feet. Since 1963, annual withdrawals have ranged from about 20,000 to 34,000 acre-feet.

The relation of water levels in wells (C-34-8)5bca-1 and (C-34-10)24cbc-2 to cumulative departure from the average annual precipitation at Parowan Power Plant, to annual withdrawals from wells, and to concentration of dissolved solids in water from well (C-33-8)31ccc-1 is shown in figure 42. Precipitation at Parowan Power Plant was 13.46 inches in 1992, 1.08 inches more than the average annual precipitation for 1935-92. The average annual precipitation for 1988-92 at Parowan Power Plant was 11.90 inches, 3.54 inches less than the average annual precipitation for the preceding five-year period, 1983-87. The concentration of dissolved solids in water from well (C-33-8)31ccc-1 has shown little change since 1976.

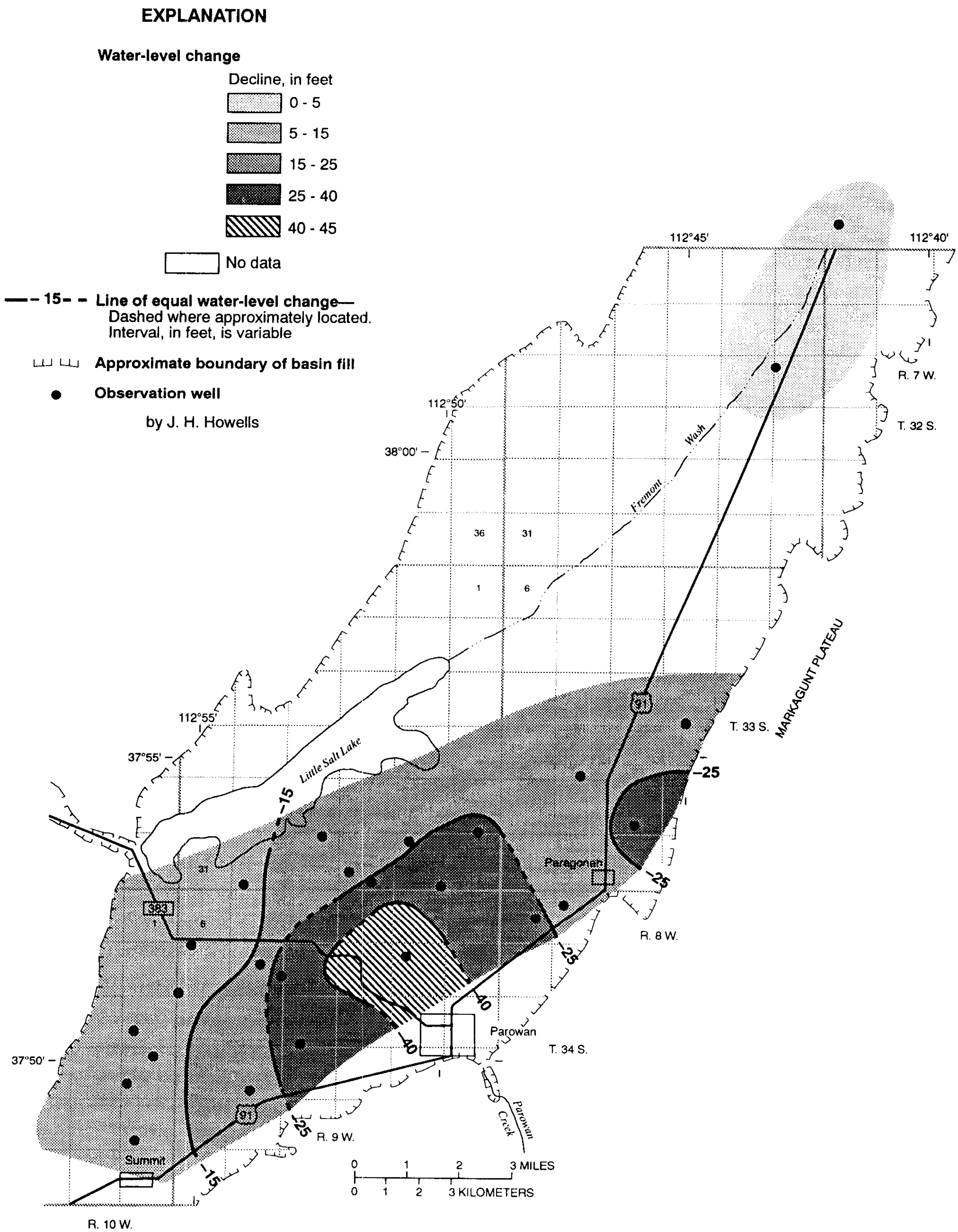

Figure 40. Map of Parowan Valley showing change of water levels from March 1988 to March 1993.

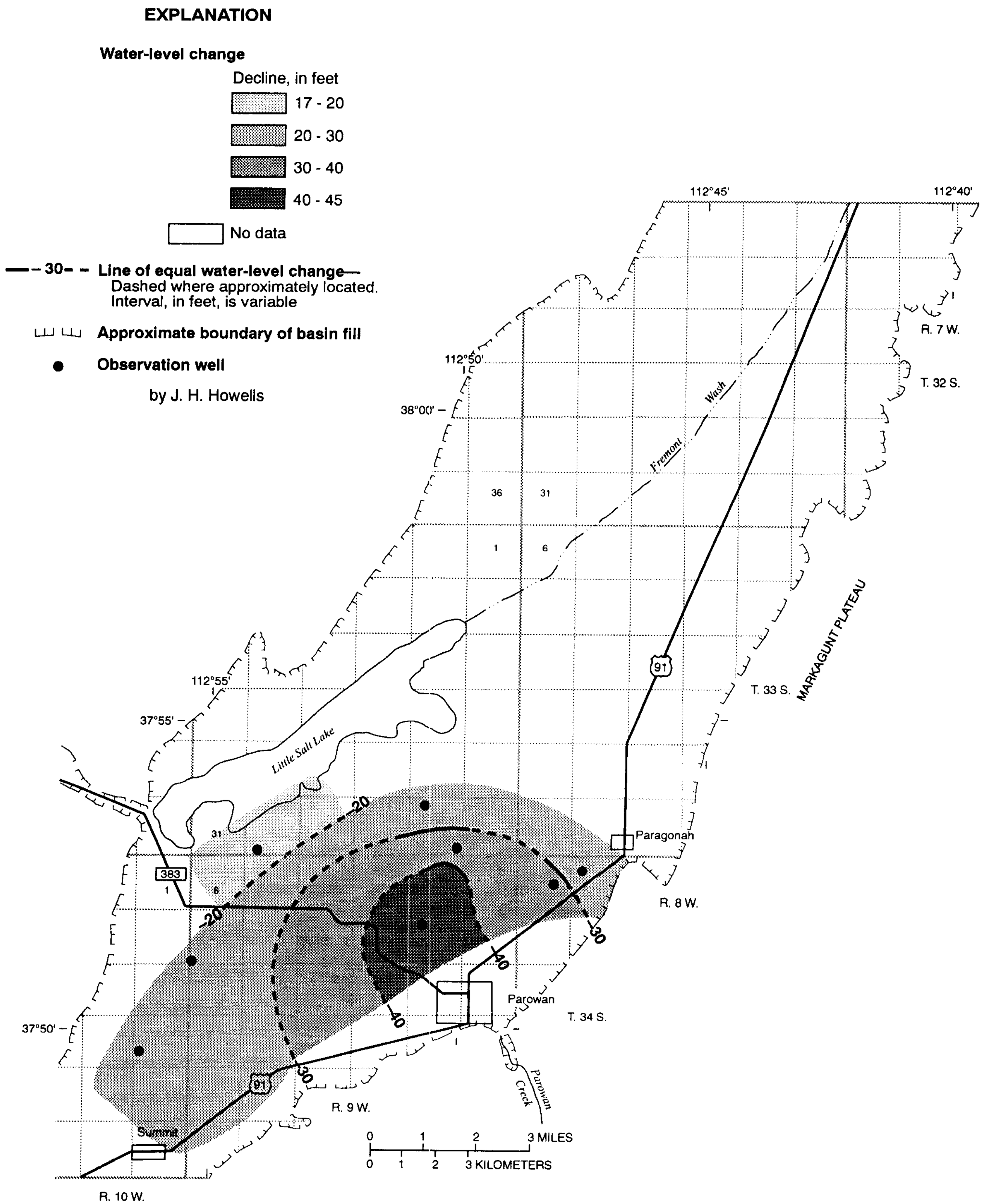

Figure 41. Map of Parowan Valley showing change of water levels from March 1963 to March 1993.

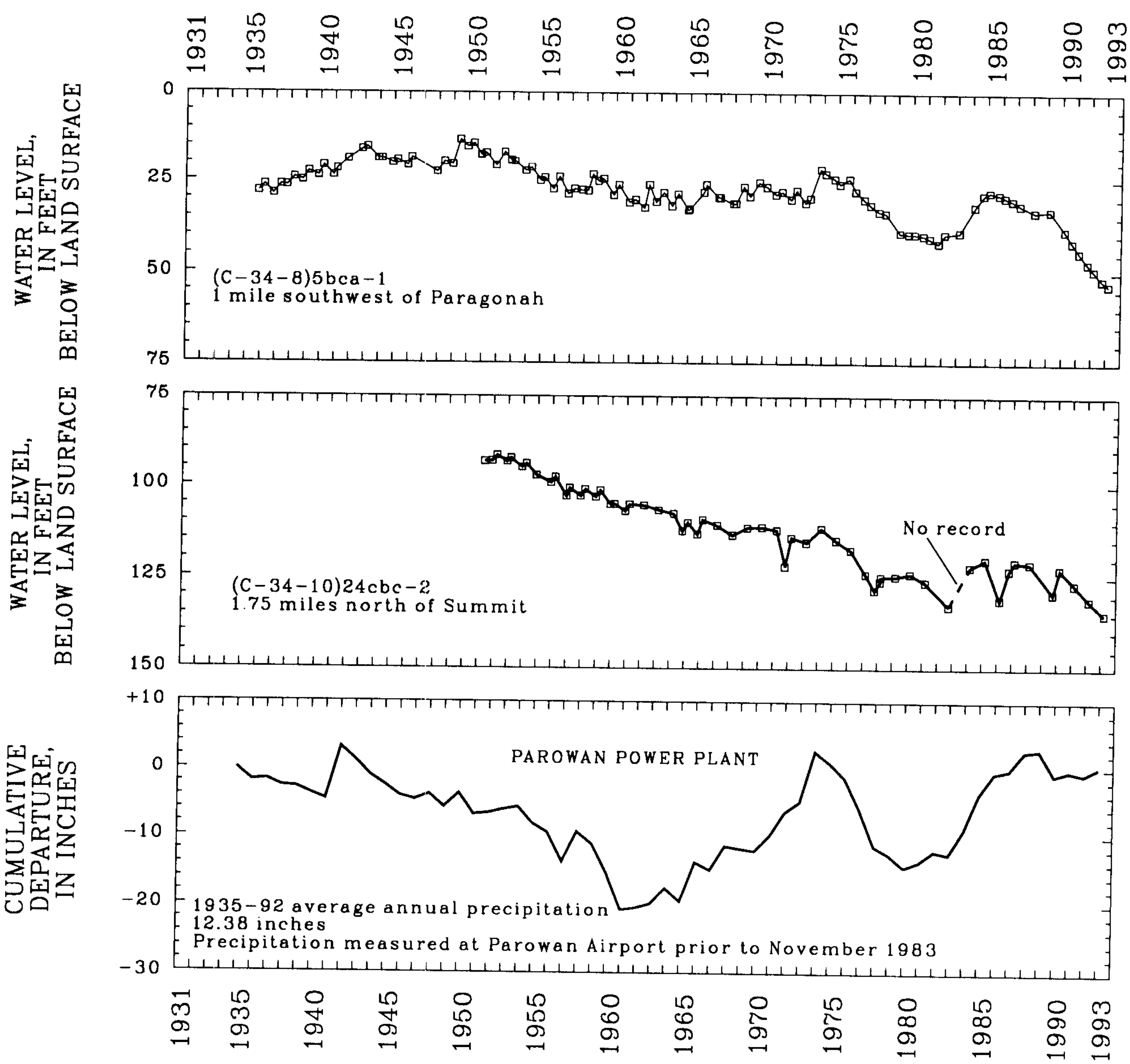

Figure 42. Relation of water levels in selected wells in Parowan Valley to cumulative departure from the average annual precipitation at Parowan Power Plant, to annual withdrawals from wells, and to concentration of dissolved solids in water from well (C-33-8)31ccc-1.

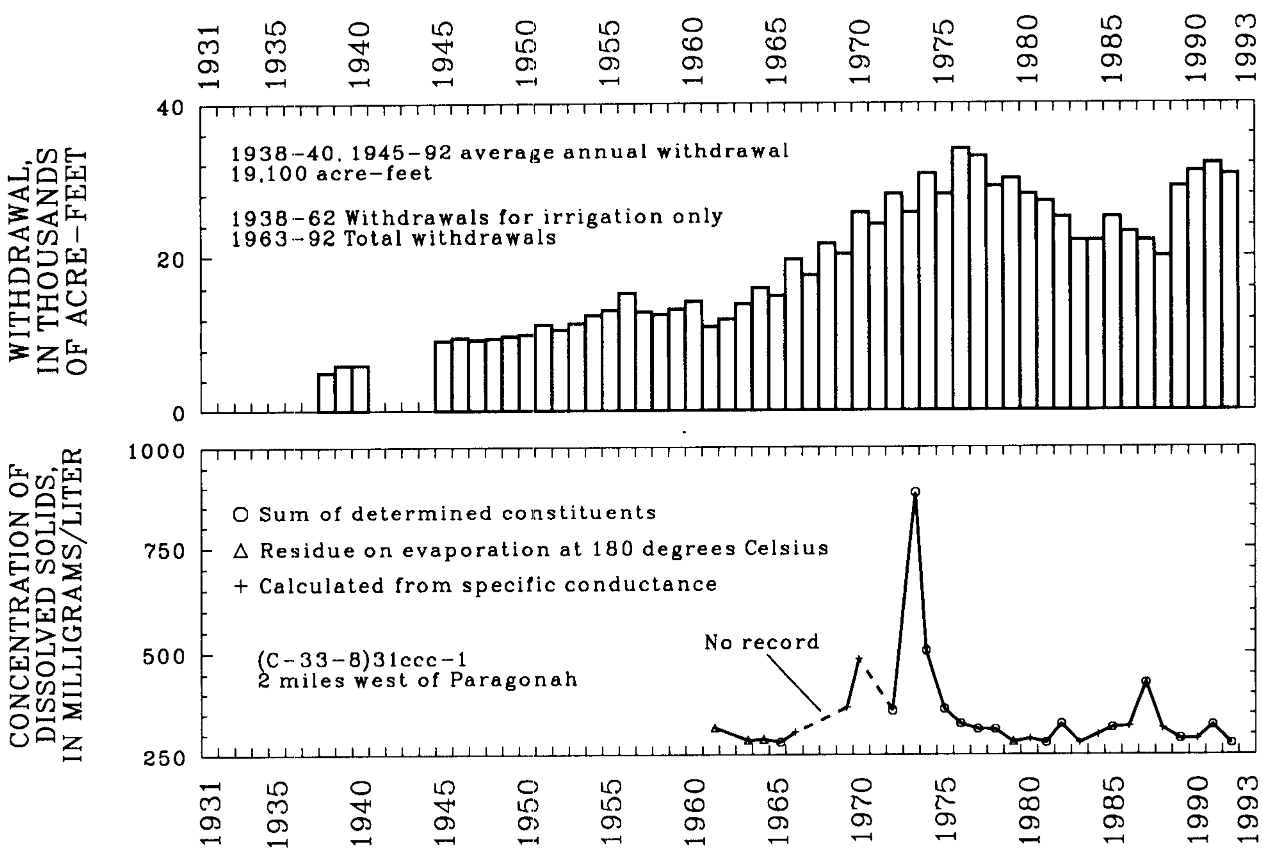

Figure 42. Relation of water levels in selected wells in Parowan Valley to cumulative departure from the average annual precipitation at Parowan Power Plant, to annual withdrawals from wells, and to concentration of dissolved solids in water from well (C-33-8)31ccc-1—Continued.

ESCALANTE VALLEY

Milford Area

by B.A. Slaugh

Withdrawal of water from wells in the Milford area of the Escalante Valley in 1992 was about 42,000 acre-feet, 12,000 acre-feet less than in 1991, and 3,000 acre-feet less than the average annual withdrawal for 1982-91 (tables 2 and 3). The average annual withdrawal for 1988-92, 46,000 acre-feet, was 4,000 acre-feet more than for the preceding five-year period, 1983-87, with withdrawals increasing each year from 1988 to 1991, then decreasing in 1992.

Water levels declined in most of the Milford area from March 1988 to March 1993 with the greatest decline, about 23 feet, measured in a well 5 miles southeast of Milford (fig. 43). Declines in water levels probably resulted from less recharge because of less precipitation and less streamflow in the Beaver River during 1988-92 than during the preceding five-year period, and from more withdrawals of water from wells during 1988-92, as compared with the preceding five-year period, 1983-87. Water levels rose almost 4 feet in the northeastern part of the valley.

Available data indicate that water levels declined in the south-central part of the Milford area from March 1963 to March 1993 (fig. 44) with the greatest decline, about 19 feet, measured in a well located 8 miles south of Milford. Declines in water levels probably resulted from continued large ground-water withdrawals, mostly for irrigation. Prior to 1963, withdrawals exceeded 45,000 acre-feet in only one year; whereas, during 1963-92, withdrawals exceeded 45,000 acre-feet in 24 of the 30 years. Water levels rose as much as 10 feet during this period in an area immediately north of Minersville.

The relation of water levels in selected wells to cumulative departure from the average annual precipitation at Black Rock, to discharge of the Beaver River at Rocky Ford Dam, to annual withdrawals from wells, and to concentration of dissolved solids in water from well (C-28-11)25dcd-1 is shown in figure 45. Precipitation at Black Rock in 1992 was 8.04 inches, 1.98 inches less than the revised quantity reported for 1991 and 0.88 inch less than the 1952-92 average annual precipitation. The average annual precipitation at Black Rock during 1988-92, 8.81 inches, was 1.63 inches less than the average during 1983-87.

Discharge of the Beaver River in 1992 was about 14,800 acre-feet, approximately 600 acre-feet more than the revised 1991 discharge and about 14,400 acre-feet less than the 1931-92 average annual discharge. The average annual discharge for 1988-92 was about 18,900 acre-feet, which was approximately 51,900 acre-feet less than the average discharge for 1983-87. The concentration of dissolved solids in water from well (C-28-11)25dcd-1 has increased from less than 600 milligrams per liter in the 1950's to about 1,400 milligrams per liter in 1992.

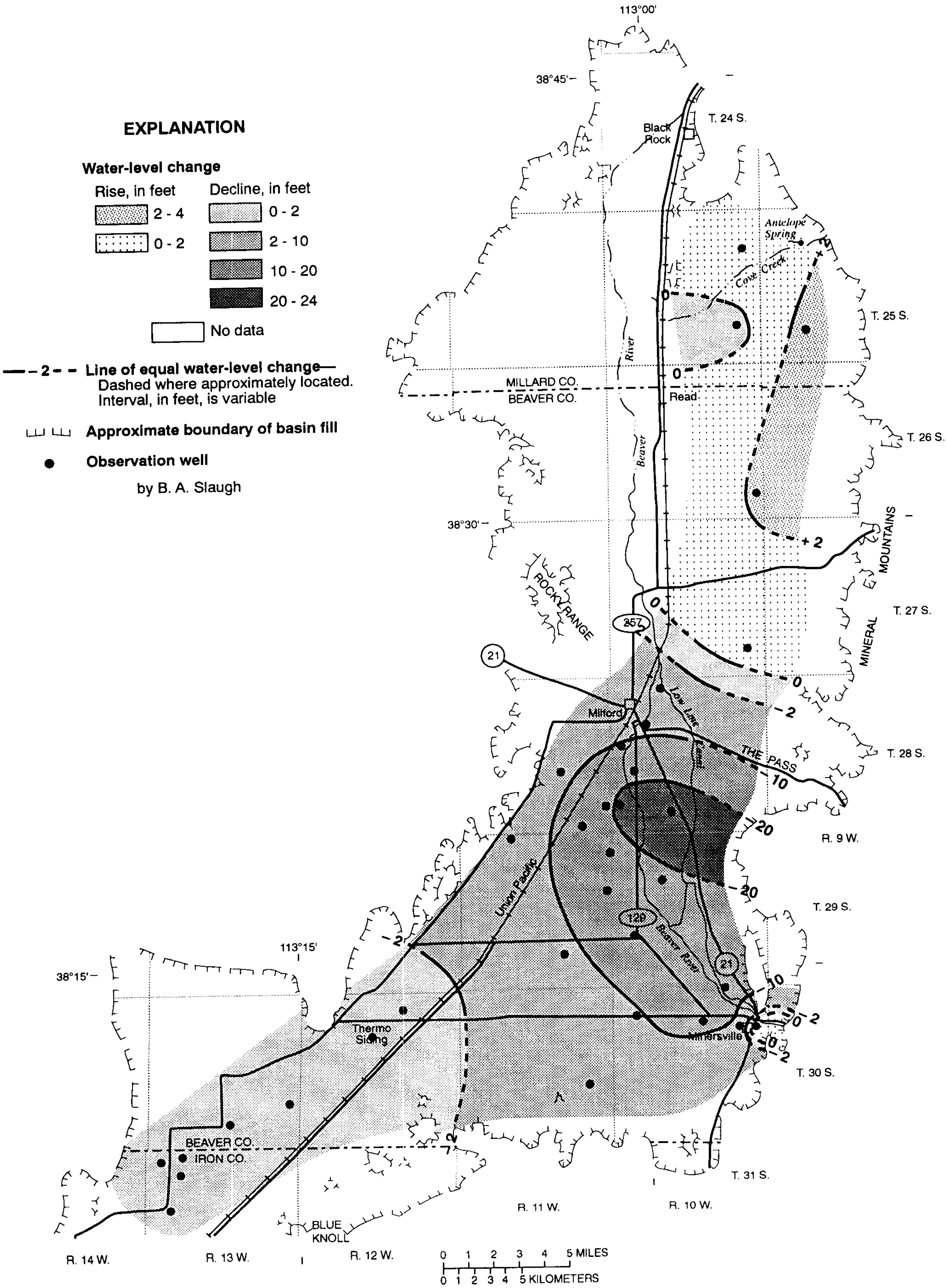

Figure 43. Map of the Milford area showing change of water levels from March 1988 to March 1993.

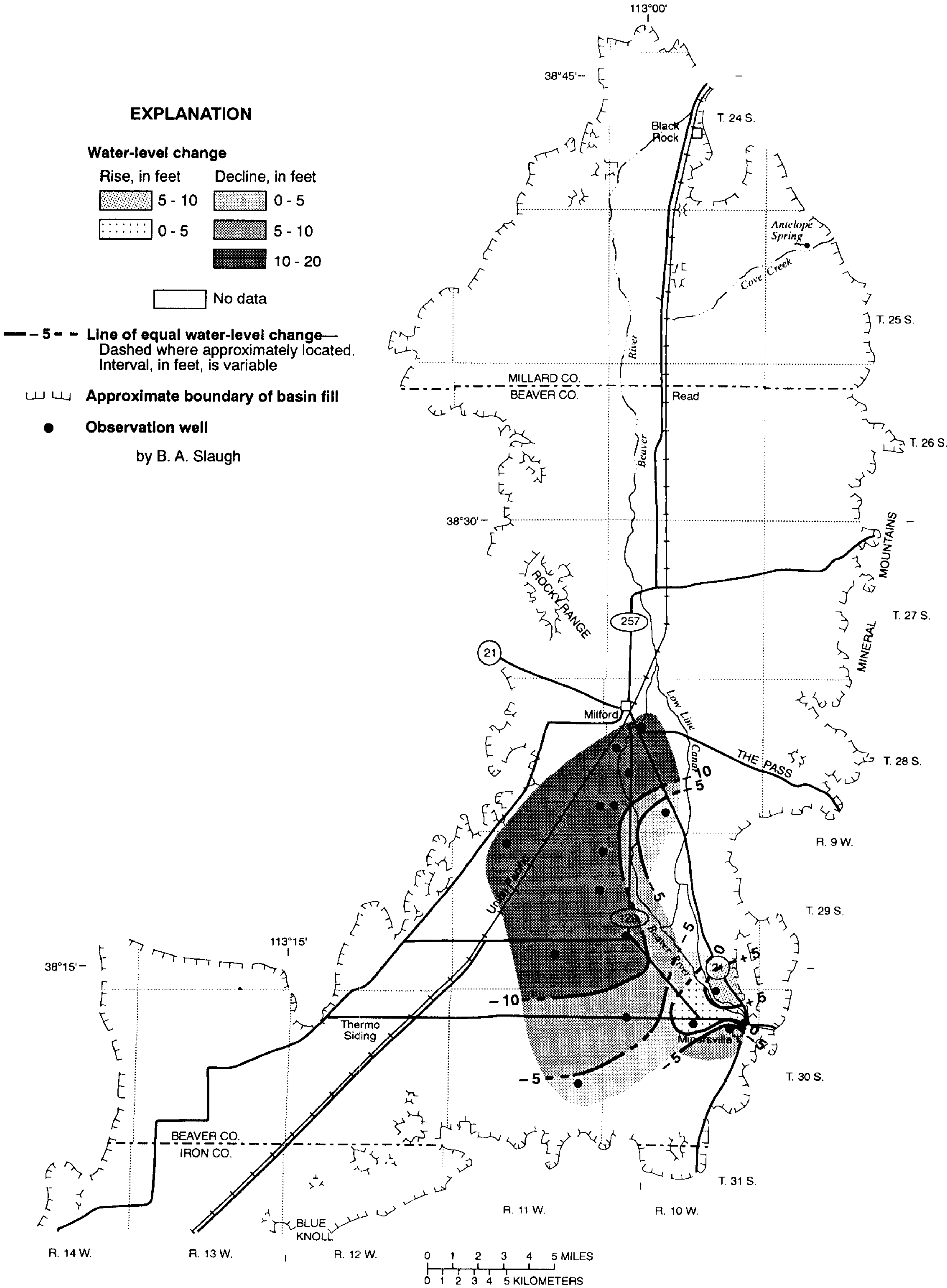

Figure 44. Map of the Milford area showing change of water levels from March 1963 to March 1993.

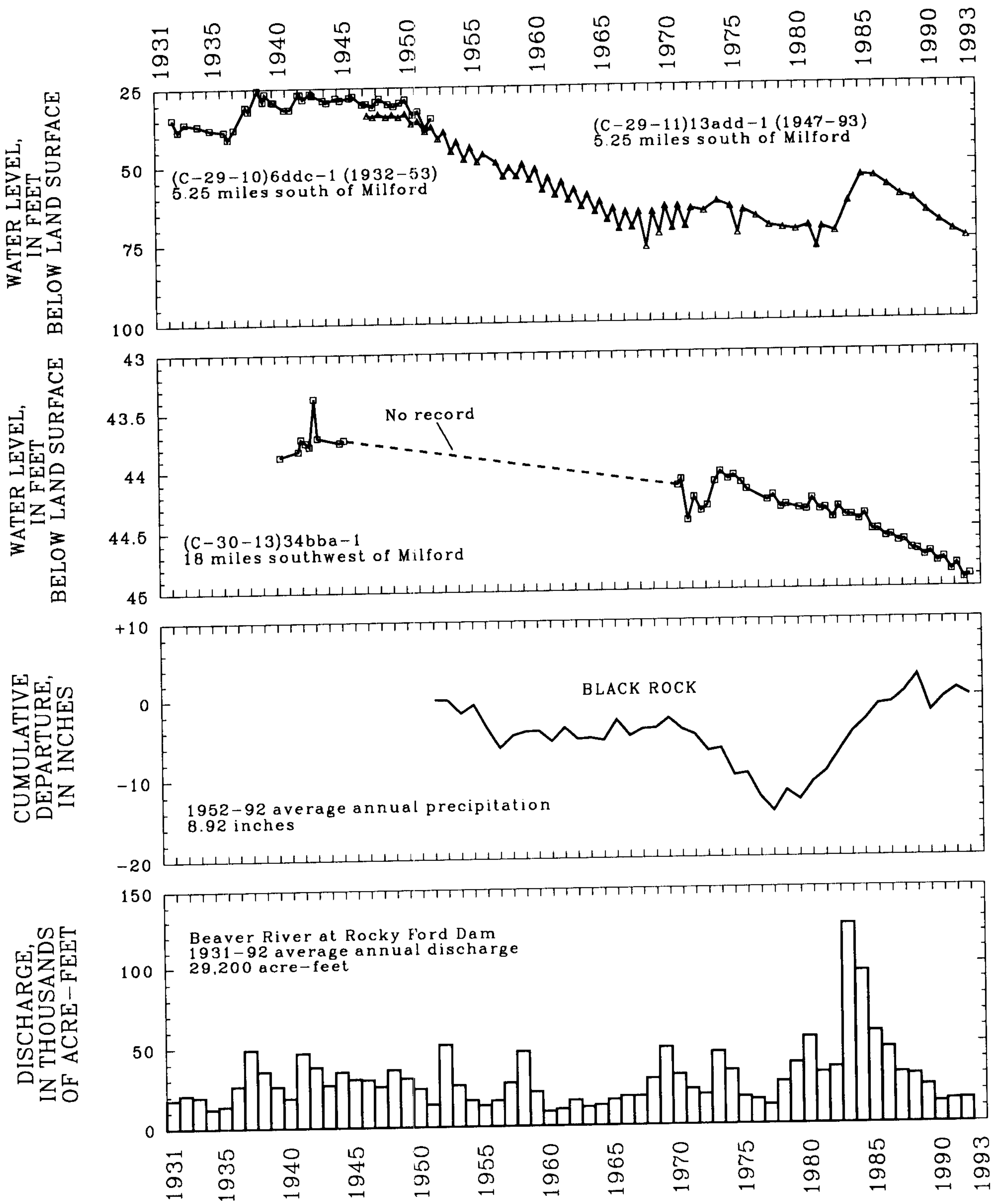

Figure 45. Relation of water levels in selected wells in the Milford area to cumulative departure from the average annual precipitation at Black Rock, to discharge of the Beaver River at Rocky Ford Dam, to annual withdrawals from wells, and to concentration of dissolved solids in water from well (C-28-11)25dcd-1.

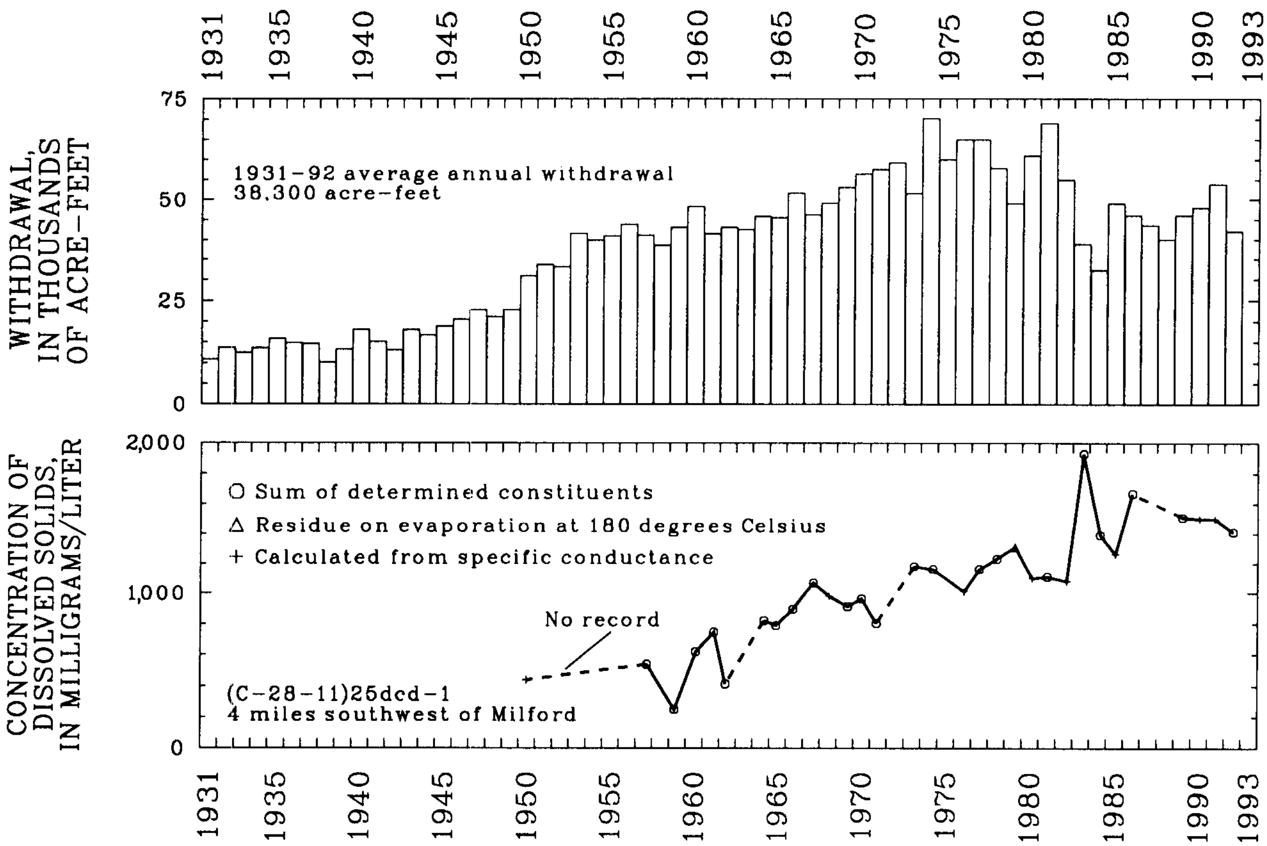

Figure 45. Relation of water levels in selected wells in the Milford area to cumulative departure from the average annual precipitation at Black Rock, to discharge of the Beaver River at Rocky Ford Dam, to annual withdrawals from wells, and to concentration of dissolved solids in water from well (C-28-11)25dcd-1—Continued.

ESCALANTE VALLEY

Beryl-Enterprise Area

by H.K. Christiansen

Withdrawal of water from wells in the Beryl-Enterprise area was about 72,000 acre-feet in 1992, 7,000 acre-feet less than was reported in 1991, and about 19,000 acre-feet less than the average annual withdrawal for 1982-91 (tables 2 and 3). The average annual withdrawal for 1988-92, 82,000 acre-feet, was 12,000 acre-feet less than the average annual withdrawal for the preceding five-year period, 1983-87.

Water levels declined from March 1988 to March 1993 in most of the Beryl-Enterprise area (fig. 46); however, water levels rose slightly in the northern part of the valley. The overall declines are primarily the result of continued large withdrawals for irrigation and possibly less recharge because of less precipitation during 1988-92 than during the preceding five-year period, 1983-87. The largest declines, about 15 to 21 feet, were measured south and southwest of Beryl Junction. Withdrawals of water during 1981-88 from a mine about 6 miles north of Enterprise were diverted to the area north of Beryl Junction and used to recharge the ground-water system. These withdrawals and the resulting recharge ceased in December 1988.

Water levels declined from March 1963 to March 1993 in most of the Beryl-Enterprise area (fig. 47). Water levels rose about 1 foot in an area near Lund, and they rose between 15 and about 28 feet in the area south and west of Enterprise along Shoal and Pine Creeks. However, data were insufficient to prepare a contour map of water-level change for these areas. Declines of about 30 to 58 feet occurred in the primary area of ground-water withdrawals around Beryl Junction. The declines primarily are the result of continued large withdrawals for irrigation. Prior to 1963, annual withdrawals were less than about 65,000 acre-feet; from 1963 through 1992, annual withdrawals have ranged from about 65,000 to 100,000 acre-feet.

The relation of water levels in selected wells in the Beryl-Enterprise area to cumulative departure from the average annual precipitation at Modena, to annual withdrawals from wells, and to concentration of dissolved solids in water from well (C-34-16)28dcc-2 is shown in figure 48. The 1992 precipitation at Modena was 11.93 inches, 1.65 inches more than the average annual precipitation for 1936-92. Average annual precipitation during 1988-92, 10.34 inches, was 1.66 inches less than the average for 1983-87. The water level in well (C-37-16)6ccc-1 rose sharply during 1977-80 because of recharge from local flooding, but has generally declined since 1981. The concentration of dissolved solids in water from well (C-34-16)28dcc-2 increased from about 460 milligrams per liter in 1967 to about 650 milligrams per liter in 1992.

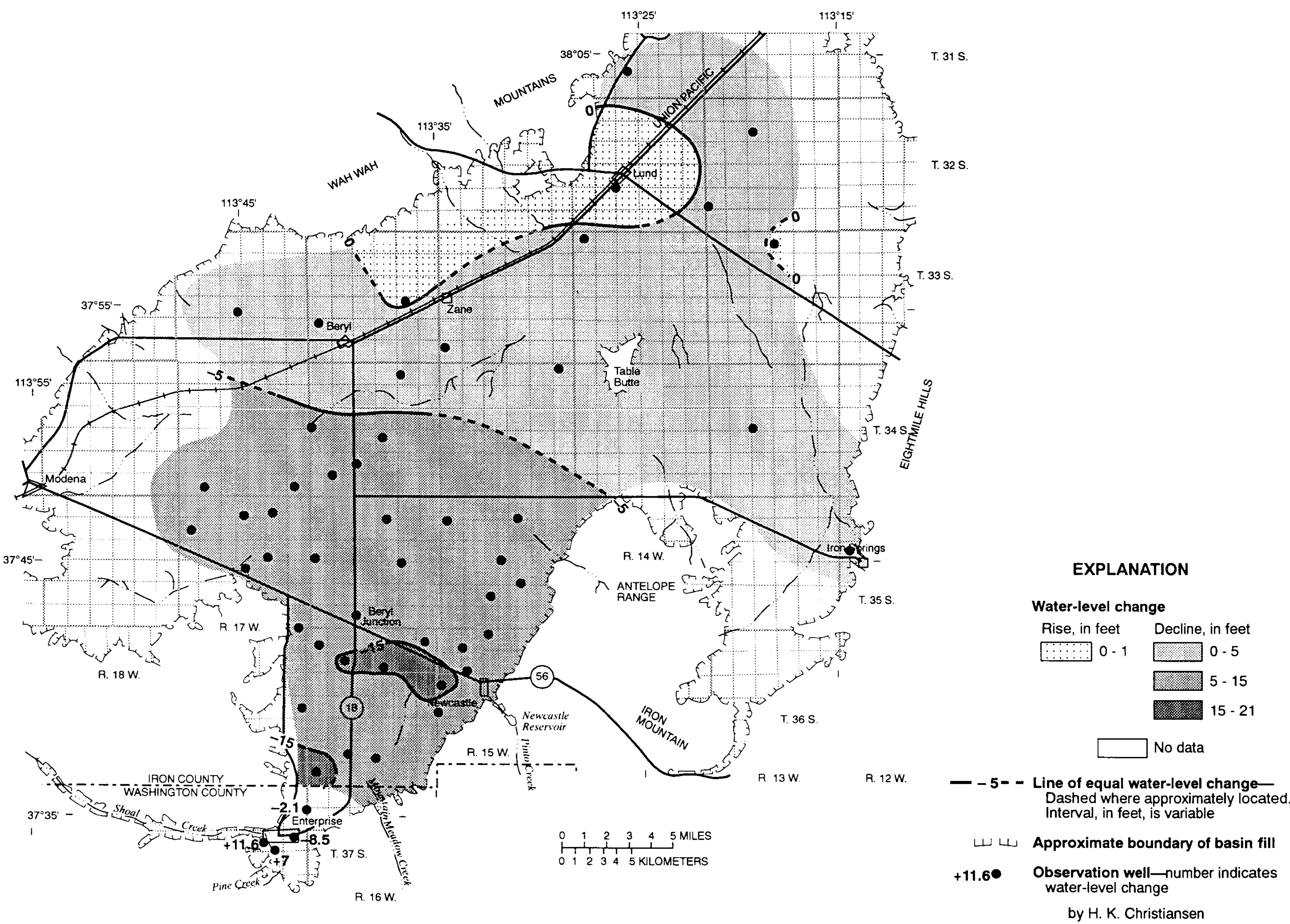

Figure 46. Map of the Beryl-Enterprise area showing change of water levels from March 1988 to March 1993.

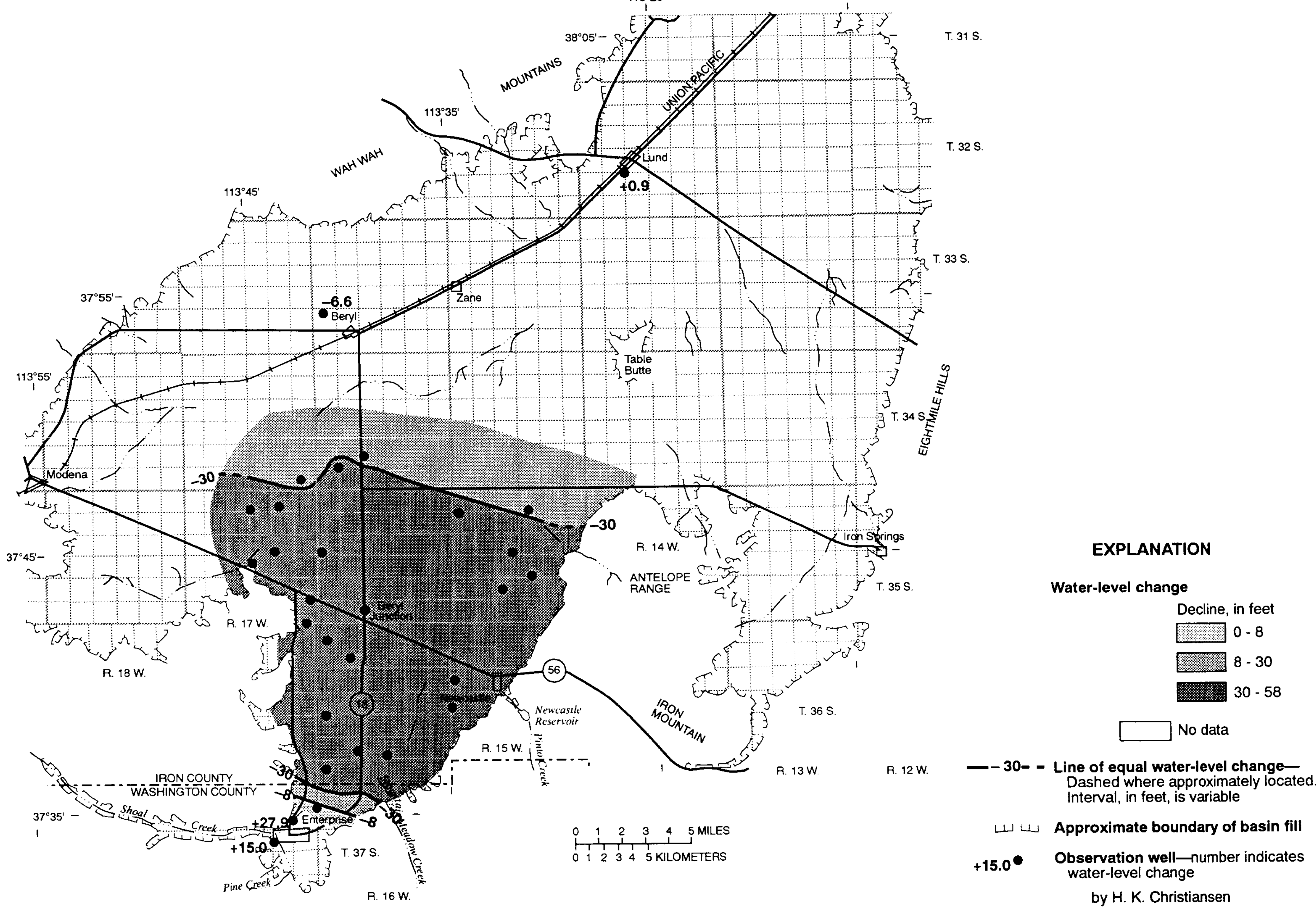

Figure 47. Map of the Beryl-Enterprise area showing change of water levels from March 1963 to March 1993.

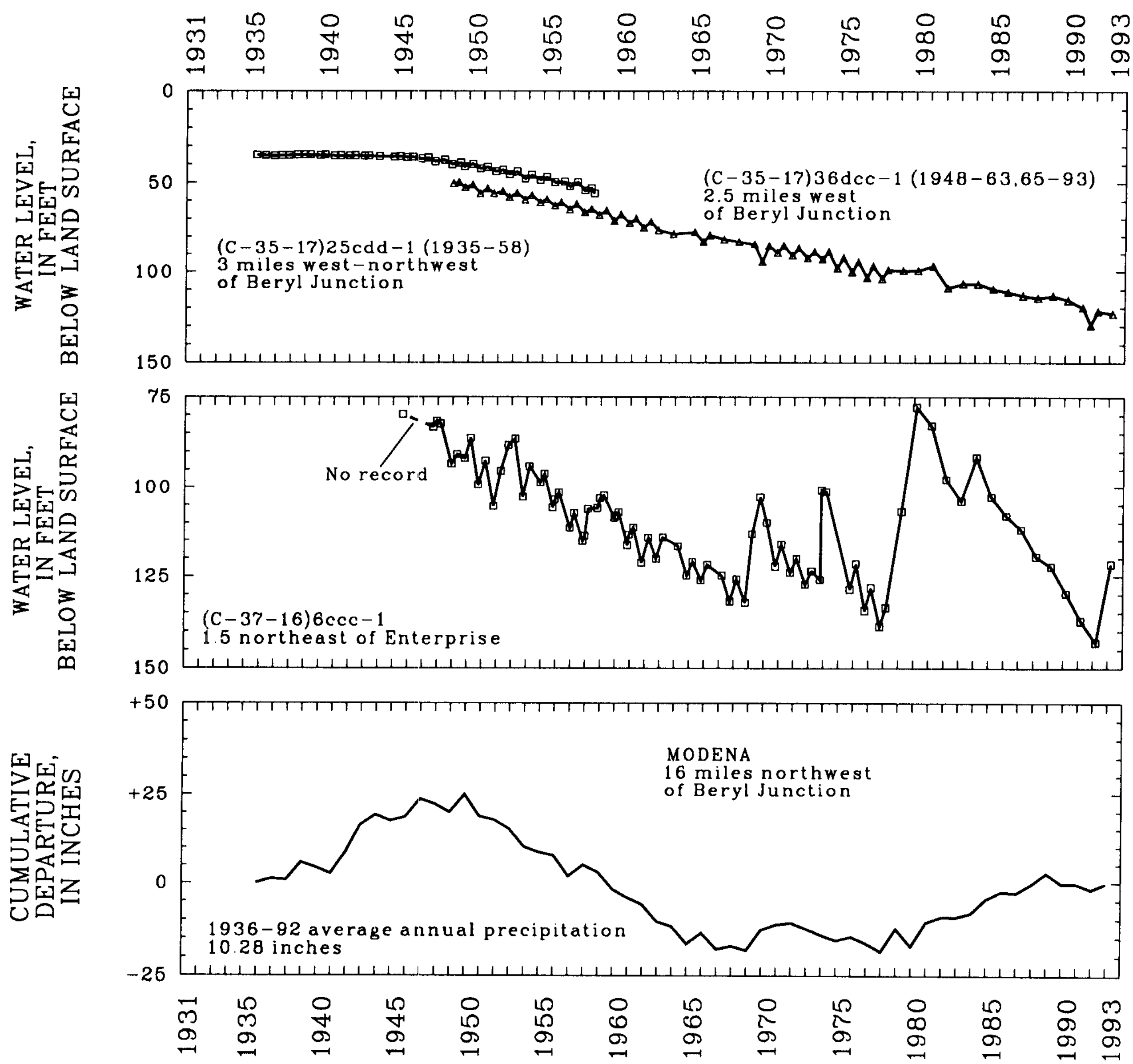

Figure 48. Relation of water levels in selected wells in the Beryl-Enterprise area to cumulative departure from the average annual precipitation at Modena, to annual withdrawals from wells, and to concentration of dissolved solids in water from well (C-34-16)28dcc-2.

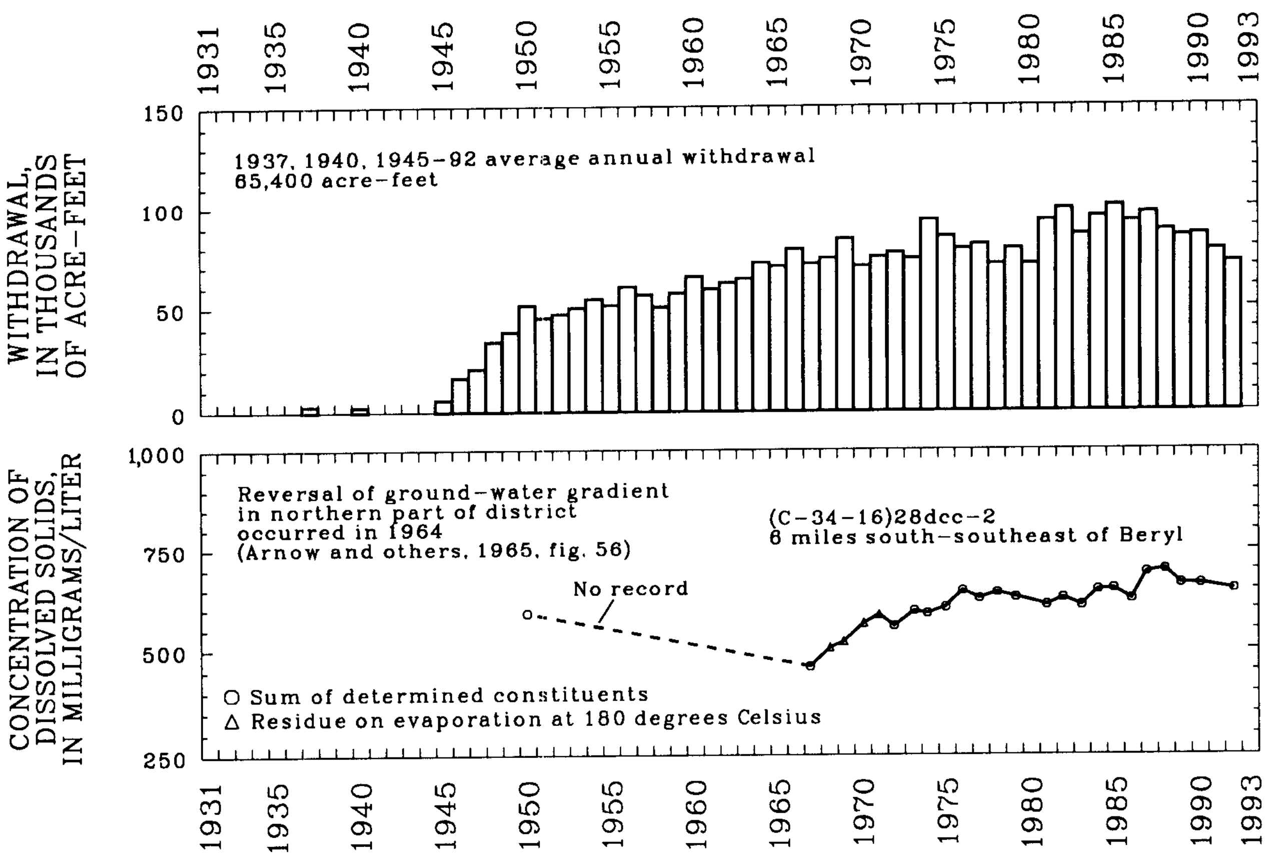

Figure 48. Relation of water levels in selected wells in the Beryl-Enterprise area to cumulative departure from the average annual precipitation at Modena, to annual withdrawals from wells, and to concentration of dissolved solids in water from well (C-34-16)28dcc-2—Continued.

CENTRAL VIRGIN RIVER AREA

by H.K. Christiansen

Withdrawal of water from wells in the central Virgin River area was about 14,000 acre-feet in 1992, 1,000 acre-feet less than for 1991 (revised) and 6,000 acre-feet less than the average annual withdrawal for 1982-91 (tables 2 and 3). This includes water withdrawn from valley-fill aquifers that is used primarily for irrigation and water withdrawn from consolidated rock and valley fill, most of which is used for public supply. Withdrawals for irrigation in 1992 decreased 1,100 acre-feet from 1991, and withdrawals for industry decreased 600 acre-feet for the same period. Withdrawals for public supply increased about 700 acre-feet from the 1991 estimate. The average annual withdrawal for 1988-92, 20,000 acre-feet, was about 1,000 acre-feet more than the average for the preceding five-year period, 1983-87.

Water levels rose in most of the central Virgin River area from February 1988 to February 1993 along the Santa Clara River drainage, east of St. George, and in the Leeds area (fig. 49). The greatest rise, about 8 feet, occurred southeast of St. George. The rises probably are the result of local decreases in withdrawals for irrigation and industry, and above-normal precipitation and streamflow in the Santa Clara River drainage in 1992. Water levels declined in areas south and southeast of St. George and west of Hurricane, with the largest decline of about 18 feet in the area along Ft. Pierce Wash. The decline in water levels probably is the result of less recharge because of less precipitation and surface-water flow during 1988-92 than during the preceding five-year period, 1983-87.

Data were insufficient to prepare a contour map of water-level change for the 1963-93 period. Water levels declined as much as 64 feet southeast of St. George and rose as much as 10 feet northwest of St. George from February 1963 to February 1993.

The relation of water levels in selected wells to discharge of the Virgin River at Virgin, to cumulative departure from the average annual precipitation at St. George, to annual withdrawals from wells, and to concentration of dissolved solids in water from well (C-41-17)17cba-1 is shown in figure 50. Discharge of the Virgin River was about 102,700 acre-feet in 1992, which is approximately 22,800 acre-feet more than the revised value of 79,900 acre-feet for 1991 and about 30,300 acre-feet less than the long-term average. The 1988-92 average annual discharge of about 90,350 acre-feet was 63,150 acre-feet less than during the preceding five-year period, 1983-87. Precipitation at St. George in 1992 was 10.32 inches, which is 2.49 inches more than the average annual precipitation for 1947-92. The average annual precipitation during 1988-92, 7.51 inches, was 1.22 inches less than the average for the preceding five-year period, 1983-87. The graph of concentration of dissolved solids in water from well (C-41-17)17cba-1 indicates little change since 1966.

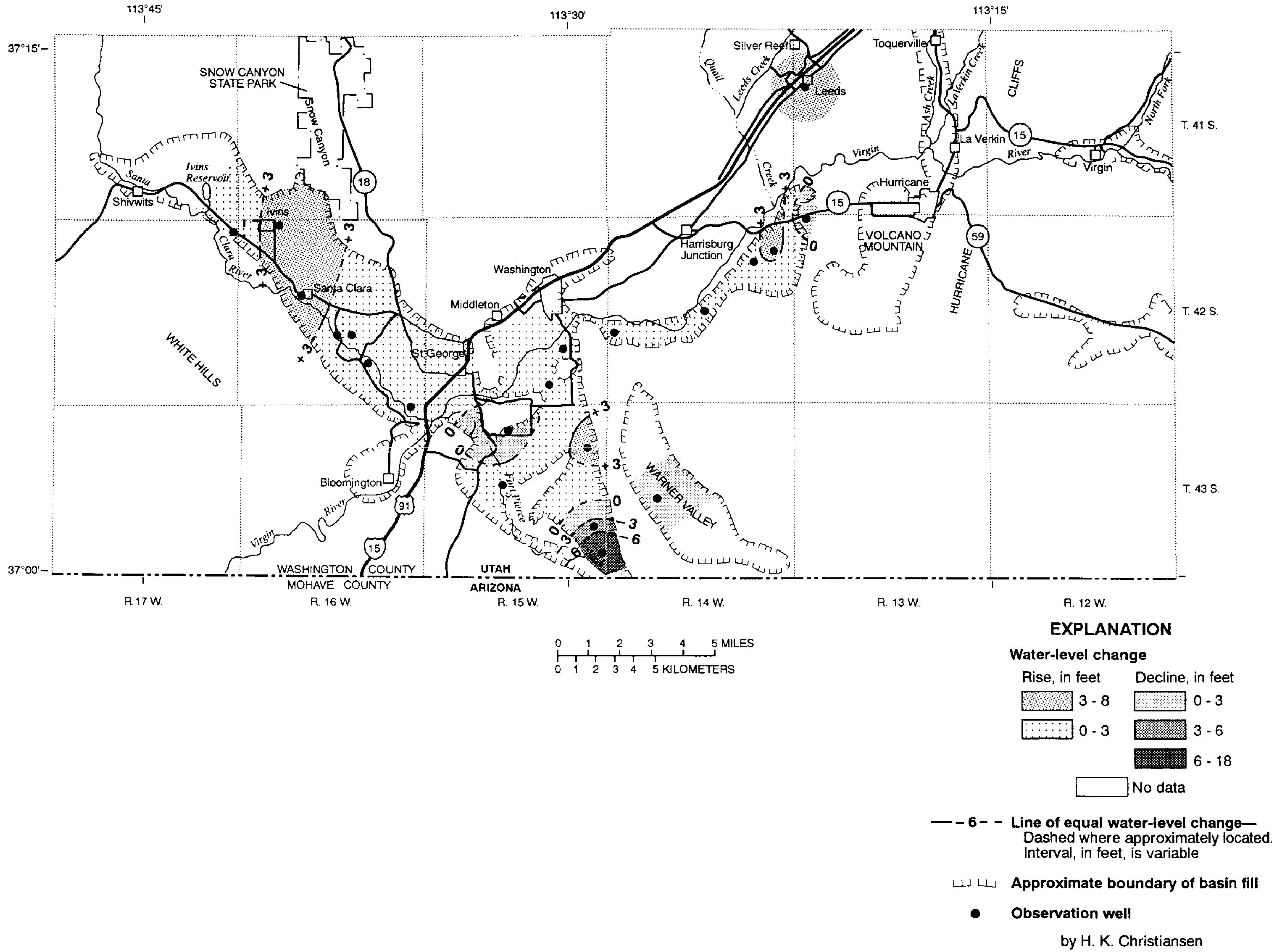

Figure 49. Map of the central Virgin River area showing change of water levels from February 1988 to February 1993.

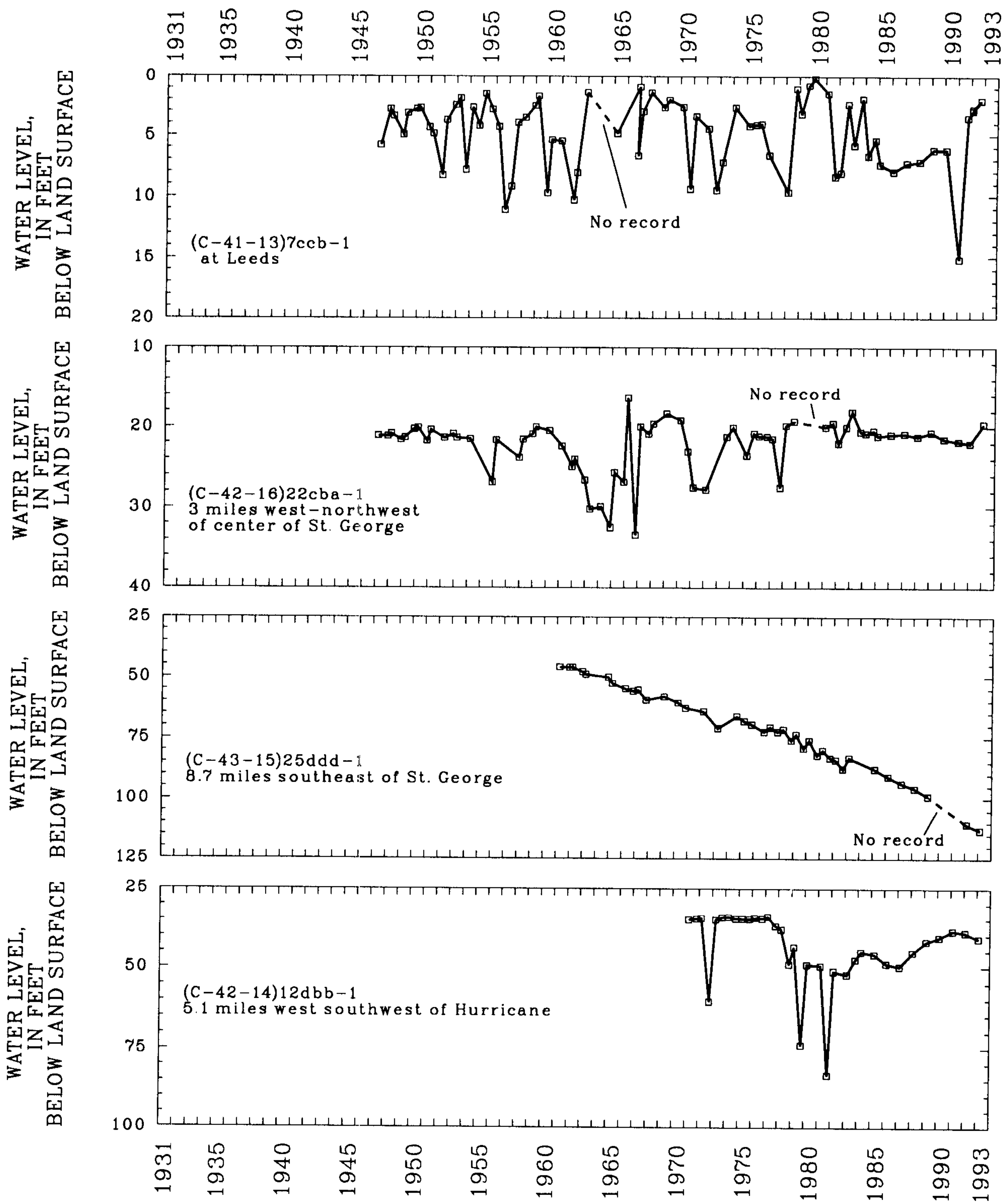

Figure 50. Relation of water levels in selected wells in the central Virgin River area to discharge of the Virgin River at Virgin, to cumulative departure from the average annual precipitation at St. George, to annual withdrawals from wells, and to concentration of dissolved solids in water from well (C-41-17)17cba-1.

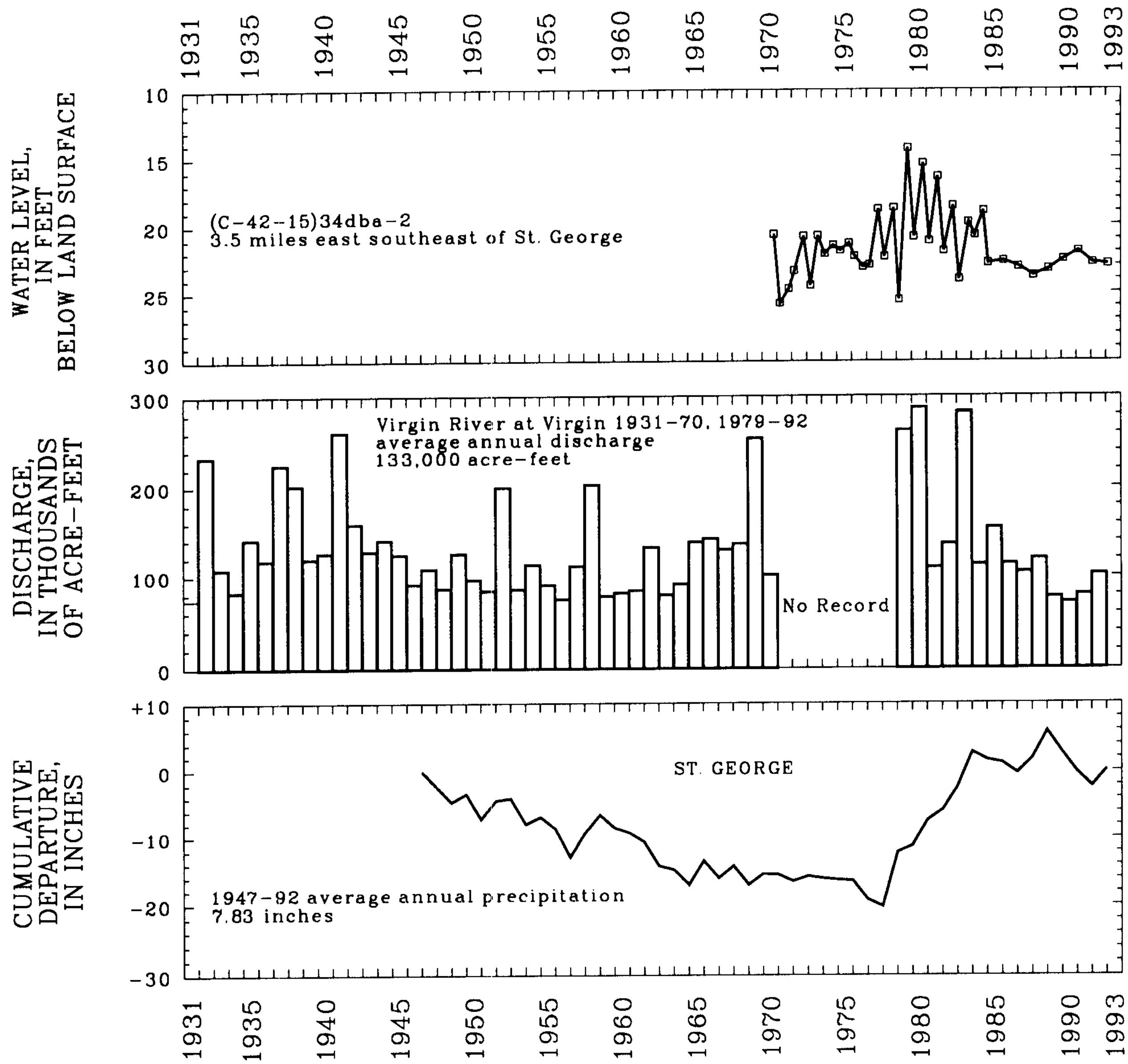

Figure 50. Relation of water levels in selected wells in the central Virgin River area to discharge of the Virgin River at Virgin, to cumulative departure from the average annual precipitation at St. George, to annual withdrawals from wells, and to concentration of dissolved solids in water from well (C-41-17)17cba-1—Continued.

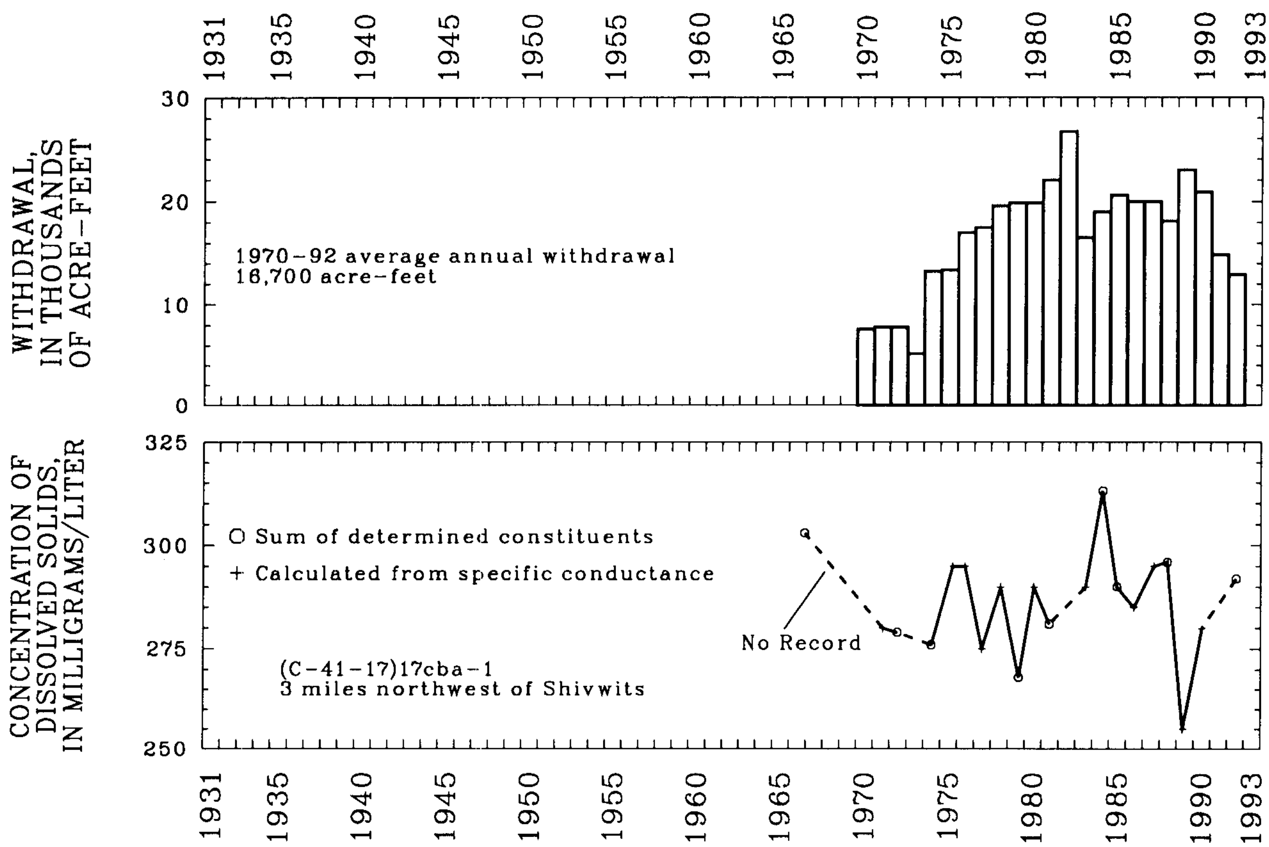

Figure 50. Relation of water levels in selected wells in the central Virgin River area to discharge of the Virgin River at Virgin, to cumulative departure from the average annual precipitation at St. George, to annual withdrawals from wells, and to concentration of dissolved solids in water from well (C-41-17)17cba-1—Continued.

OTHER AREAS

by L.R. Herbert

Approximately 120,000 acre-feet of water was withdrawn from wells in 1992 in those areas of Utah listed below:

Number in figure 1	Area	Estimated withdrawal (acre-feet) 1991	1992
1	Grouse Creek Valley	3,700	3,100
2	Park Valley	3,100	2,800
8	Ogden Valley	12,200	12,600
12	Dugway Area, Skull Valley, and Old River Bed	4,400	5,400
13	Cedar Valley, Utah County	2,500	2,600
18	Sanpete Valley	13,500	16,300
23	Snake Valley	8,400	12,200
25	Beaver Valley	7,400	7,900
	Remainder of state	56,200	57,00
Total (rounded)		111,000	120,000

The total withdrawal was 9,000 acre-feet more in 1992 than in 1991 and 32,000 acre-feet more than the average annual withdrawal for 1982-91 (tables 2 and 3). In the areas listed, withdrawals in 1992 were greater than they were in 1991, except in Grouse Creek and Park Valleys. The increase in total withdrawal mainly was because of increased withdrawals for irrigation and public supply. The average annual withdrawal for 1988-92 was 107,000 acre-feet, 36,000 acre-feet more than the average for the preceding five-year period, 1983-87.

Water-level changes in Cedar Valley, Utah County, are shown in figures 51 and 52. Water levels declined from March 1988 to March 1993 along the west side of Cedar Valley because of less-than-average precipitation resulting in less recharge during 1988-92 than during the preceding five-year period, 1983-87. The average annual precipitation at Fairfield during 1988-92 was 10.04 inches, 1.56 inches less than the long-term annual average and 6.62 inches less than for the preceding five-year period, 1983-87. The average annual withdrawal in Cedar Valley during 1988-92 was 2,600 acre-feet, 400 acre-feet more than during 1983-87. Rises in water levels along the east side of the valley may be the result of increased local recharge from irrigation using water withdrawn from a limestone aquifer. Water levels generally rose from March 1963 to March 1993 in the area northeast of Fairfield. The rise probably was because of generally above-average precipitation since 1976.

Water levels declined in Sanpete Valley from March 1988 to March 1993 (fig. 53). The declines resulted from less recharge because of less precipitation and greater withdrawals during 1988-92 than during the preceding five-year period, 1983-87. Although data were lacking to define water-level changes from 1963 to 1993 in Sanpete Valley, the water level in observation well (D-17-3)9cbd-1 near Ephraim declined about 15 feet during this period. The average annual precipitation at Manti during 1988-92 was 12.24 inches, 3.90 inches less than during the preceding five-year period, 1983-87. The average annual withdrawal of water from wells during 1988-92 was about 15,000 acre-feet, 7,000 acre-feet more than the average for the preceding five-year period, 1983-87

The relation of water levels in 19 selected observation wells to cumulative departure from the average annual precipitation at 17 sites in or near those areas is shown in figure 54. Water levels declined from March 1988 to March

1993 in 13 and rose in 4 of the 19 observation wells. The declines probably were the result of less recharge because of less precipitation and larger withdrawals of water from wells during 1988-92 than during the preceding five-year period, 1983-87. Average annual precipitation during 1988-92 was less than during 1983-87 at all 17 precipitation sites. Water levels declined in 6 and rose in 9 of the 19 observation wells from March 1963 to March 1993.

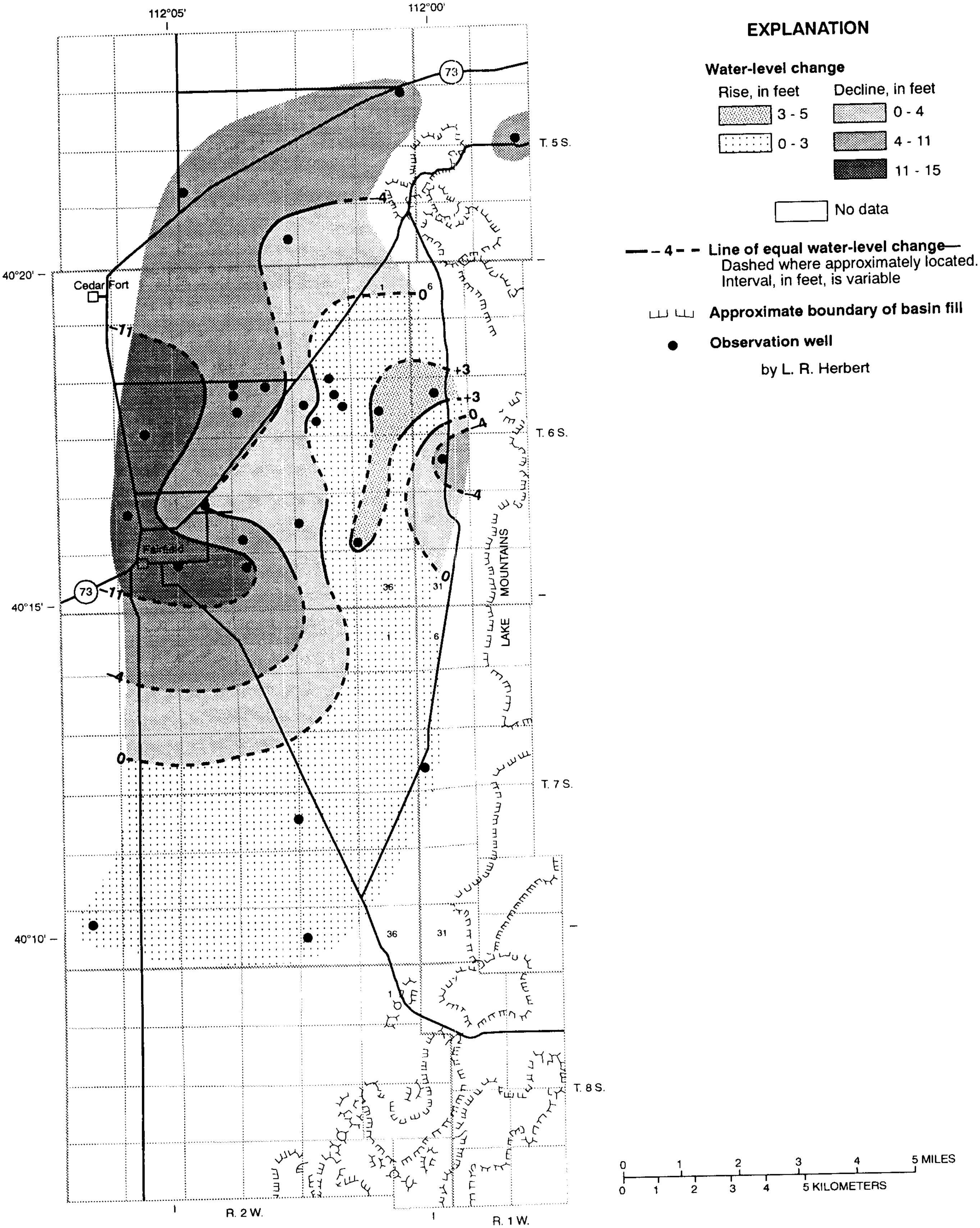

Figure 51. Map of Cedar Valley, Utah County, showing change of water levels from March 1988 to March 1993.

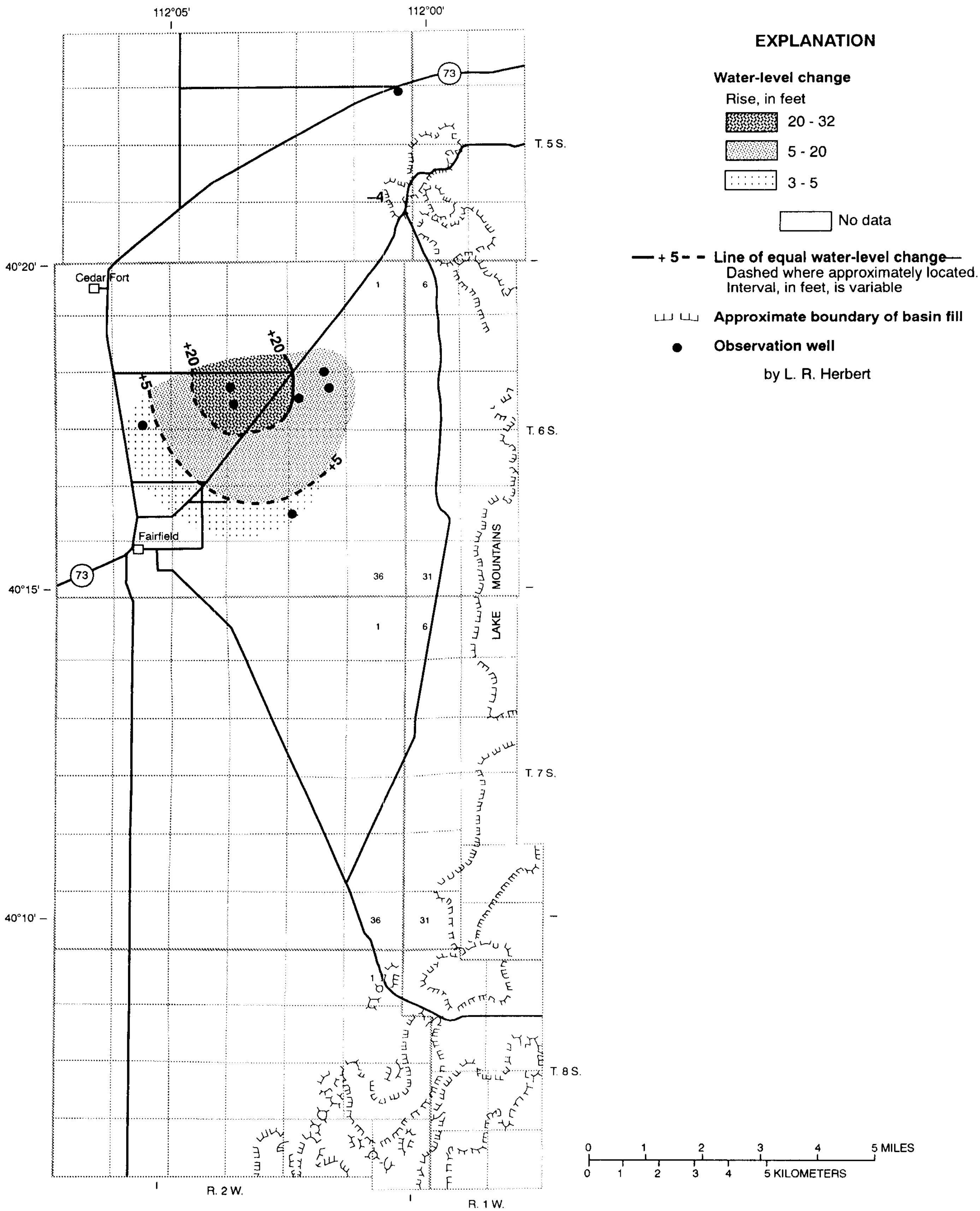

Figure 52. Map of Cedar Valley, Utah County, showing change of water levels from March 1963 to March 1993.

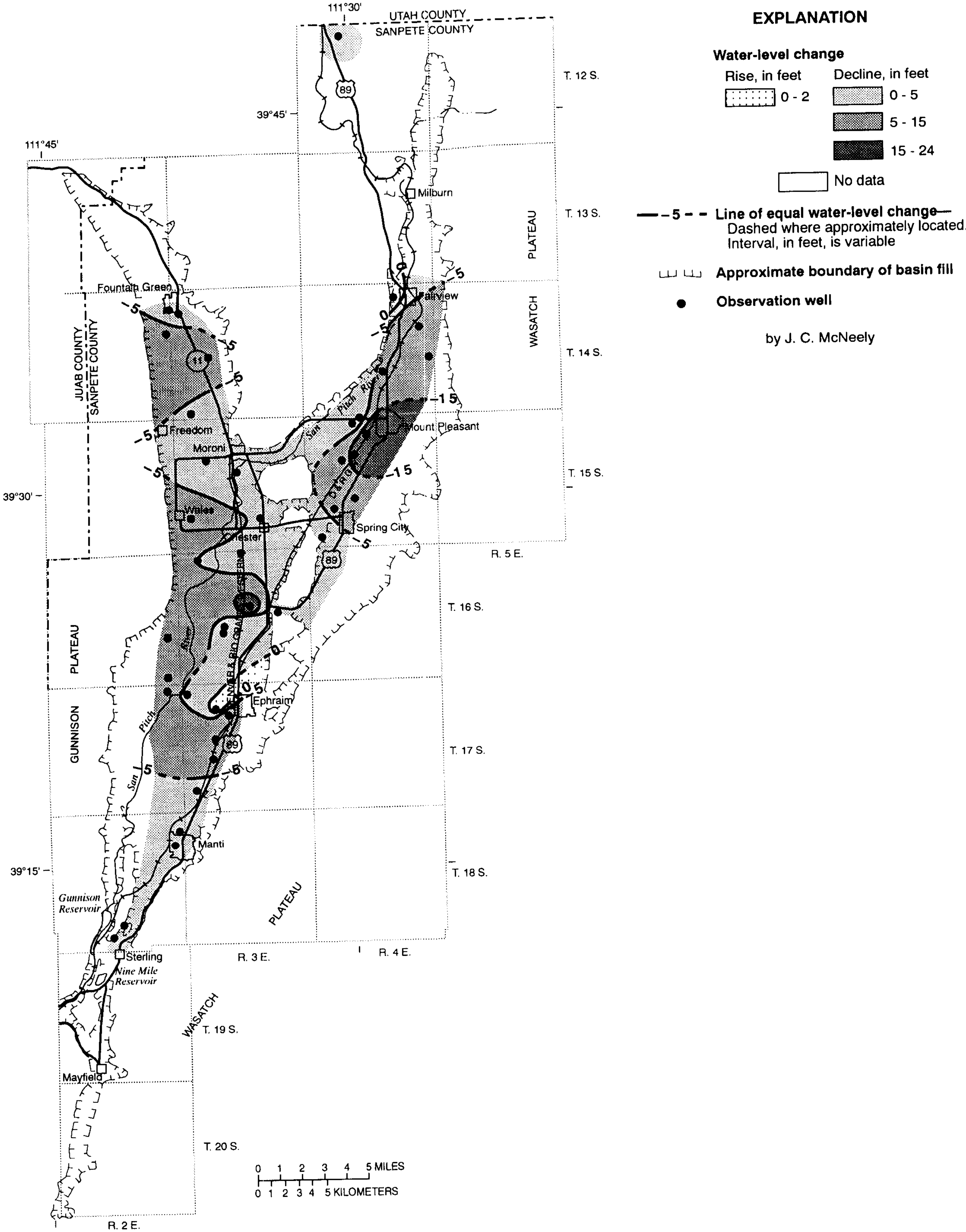

Figure 53. Map of Sanpete Valley showing change of water levels from March 1988 to March 1993.

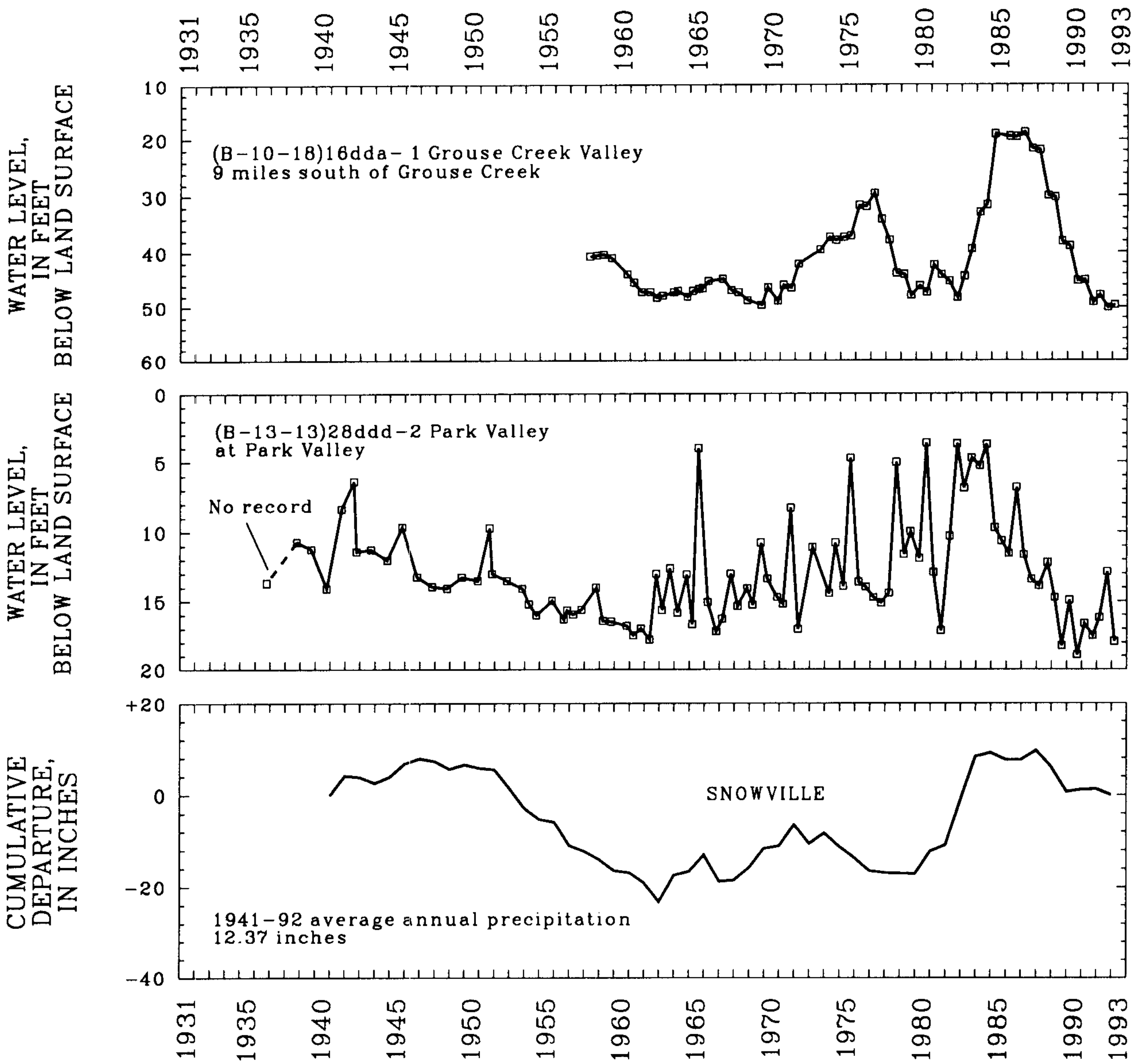

Figure 54. Relation of water levels in wells in selected areas of Utah to cumulative departure from the average annual precipitation at sites in or near those areas.

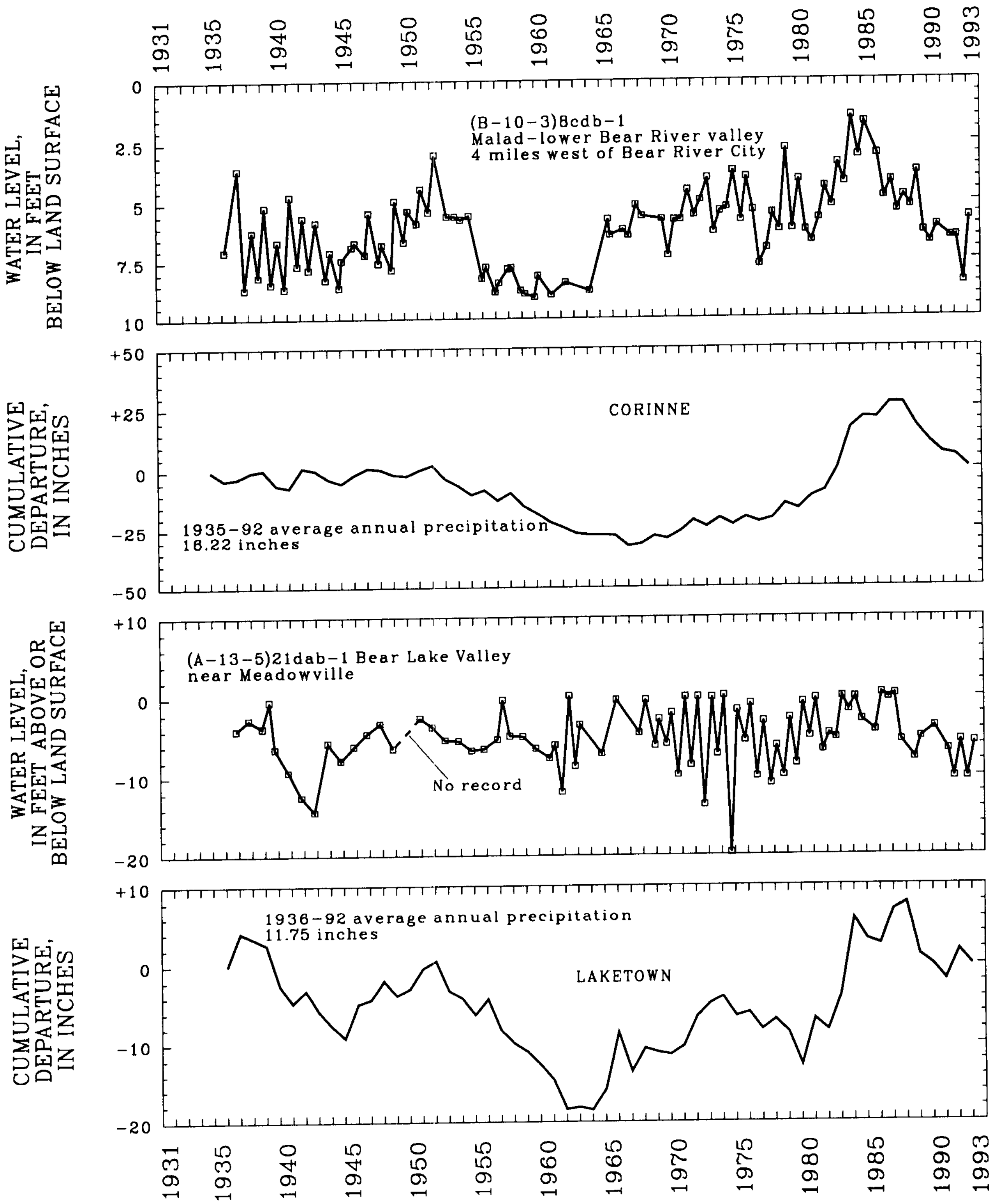

Figure 54. Relation of water levels in wells in selected areas of Utah to cumulative departure from the average annual precipitation at sites in or near those areas—Continued.

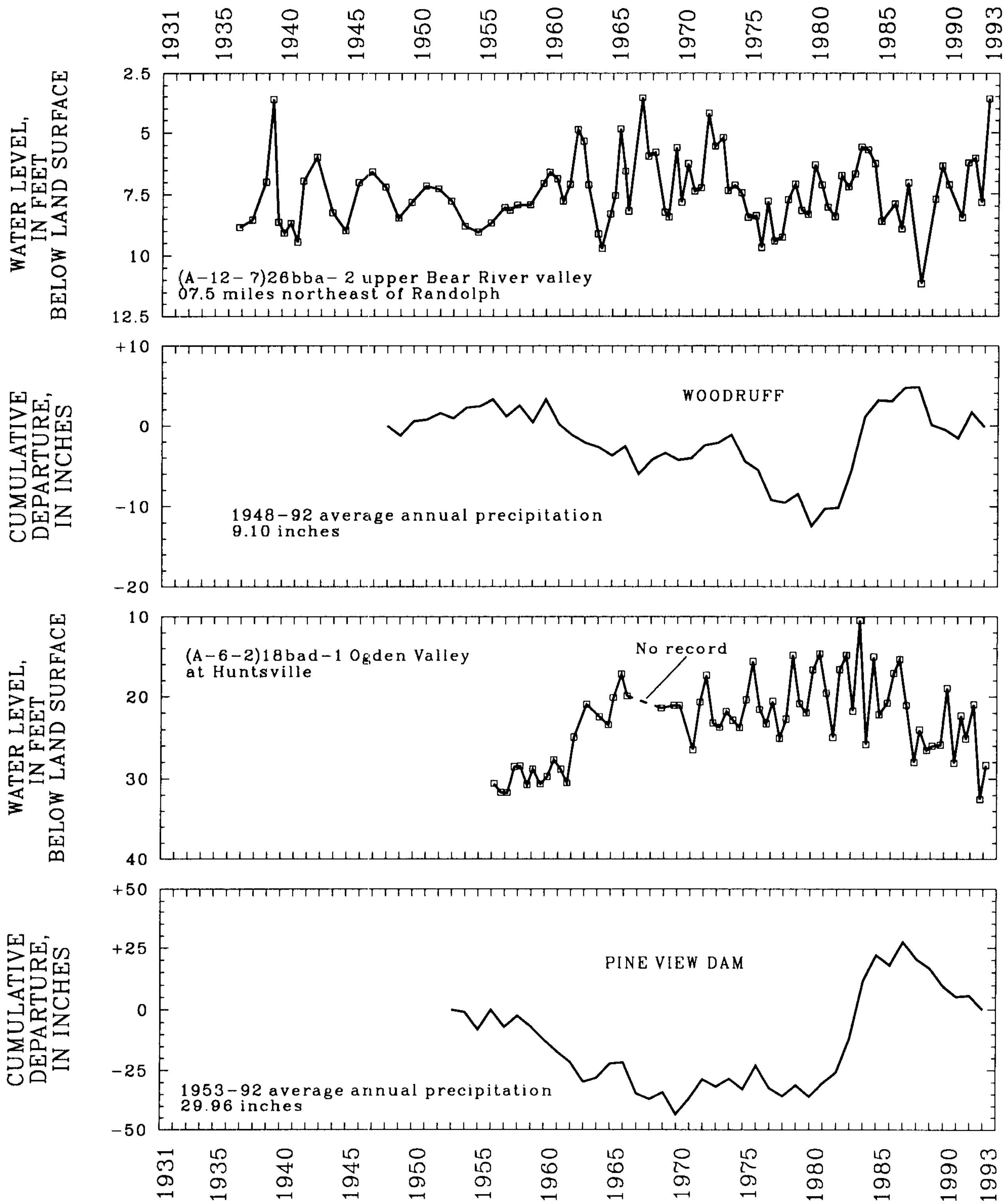

Figure 54. Relation of water levels in wells in selected areas of Utah to cumulative departure from the average annual precipitation at sites in or near those areas—Continued.

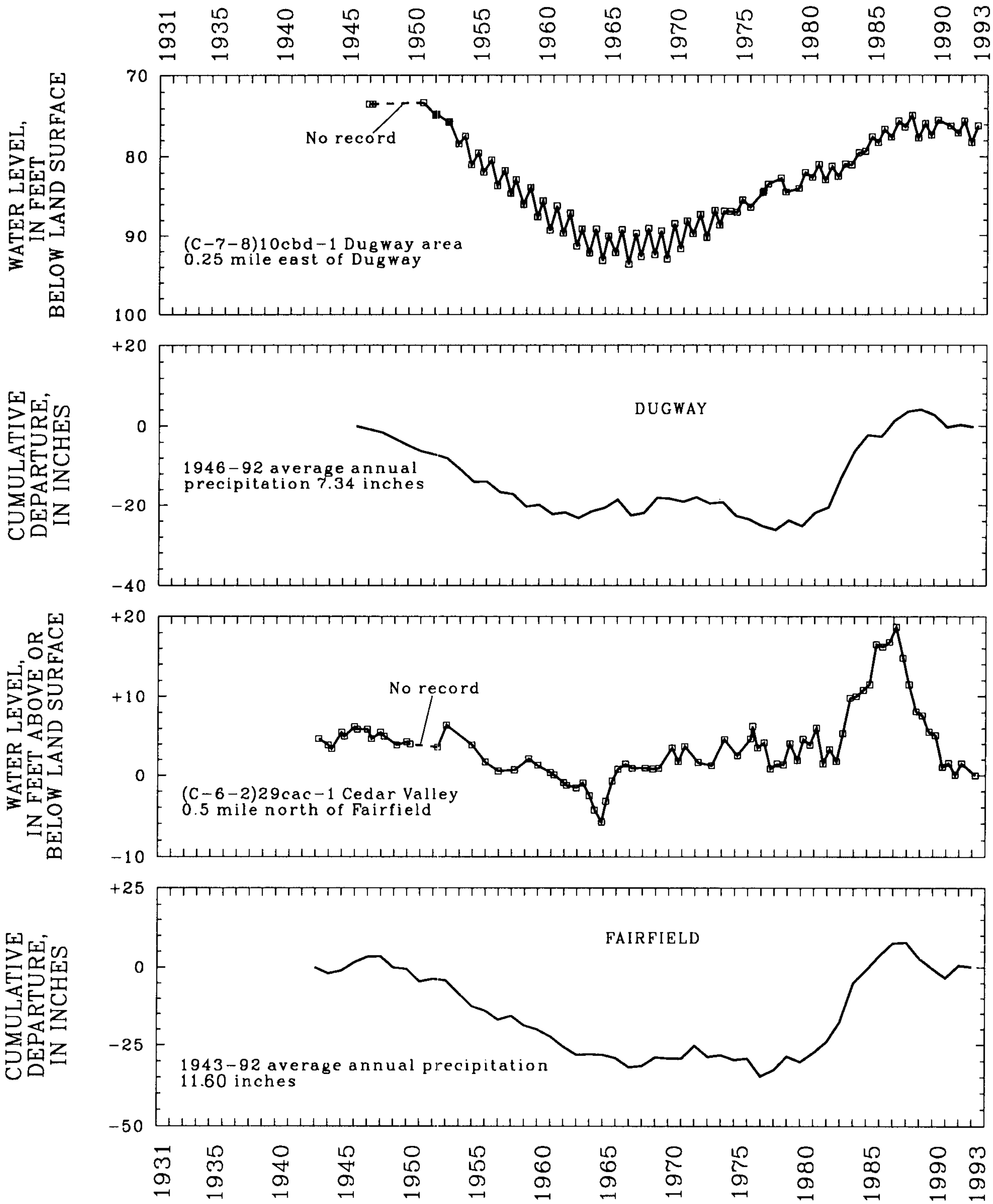

Figure 54. Relation of water levels in wells in selected areas of Utah to cumulative departure from the average annual precipitation at sites in or near those areas—Continued.

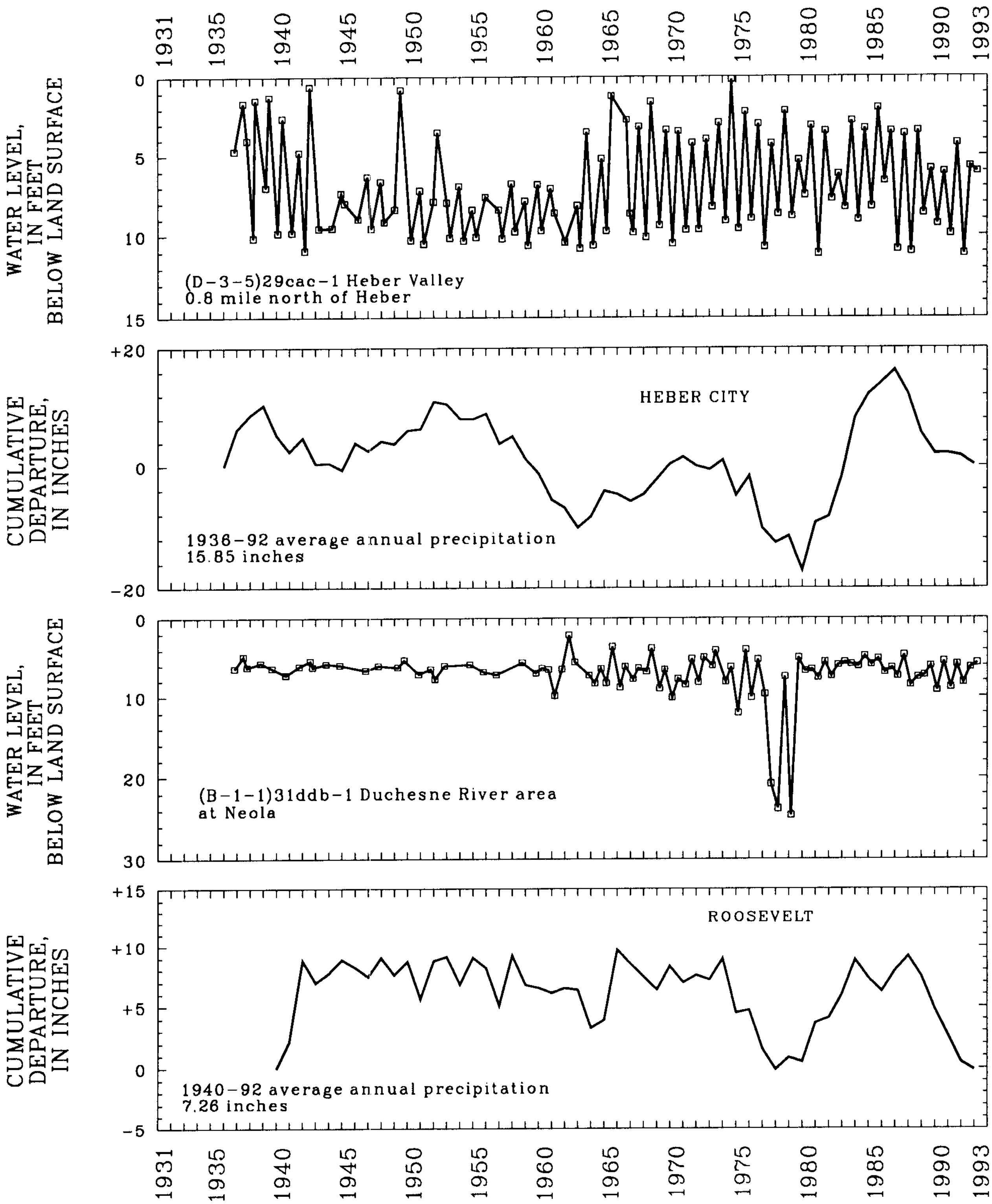

Figure 54. Relation of water levels in wells in selected areas of Utah to cumulative departure from the average annual precipitation at sites in or near those areas—Continued.

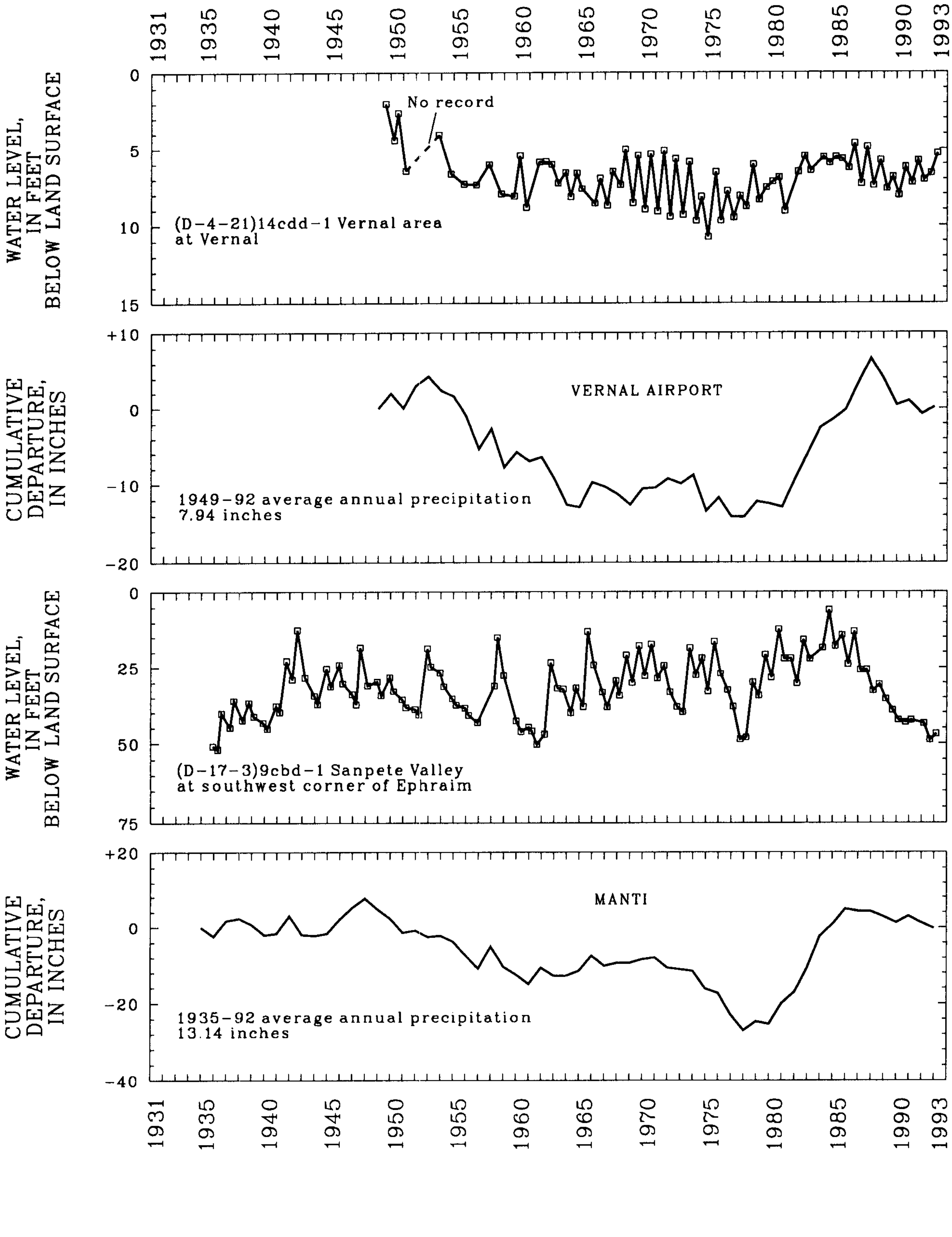

Figure 54. Relation of water levels in wells in selected areas of Utah to cumulative departure from the average annual precipitation at sites in or near those areas—Continued.

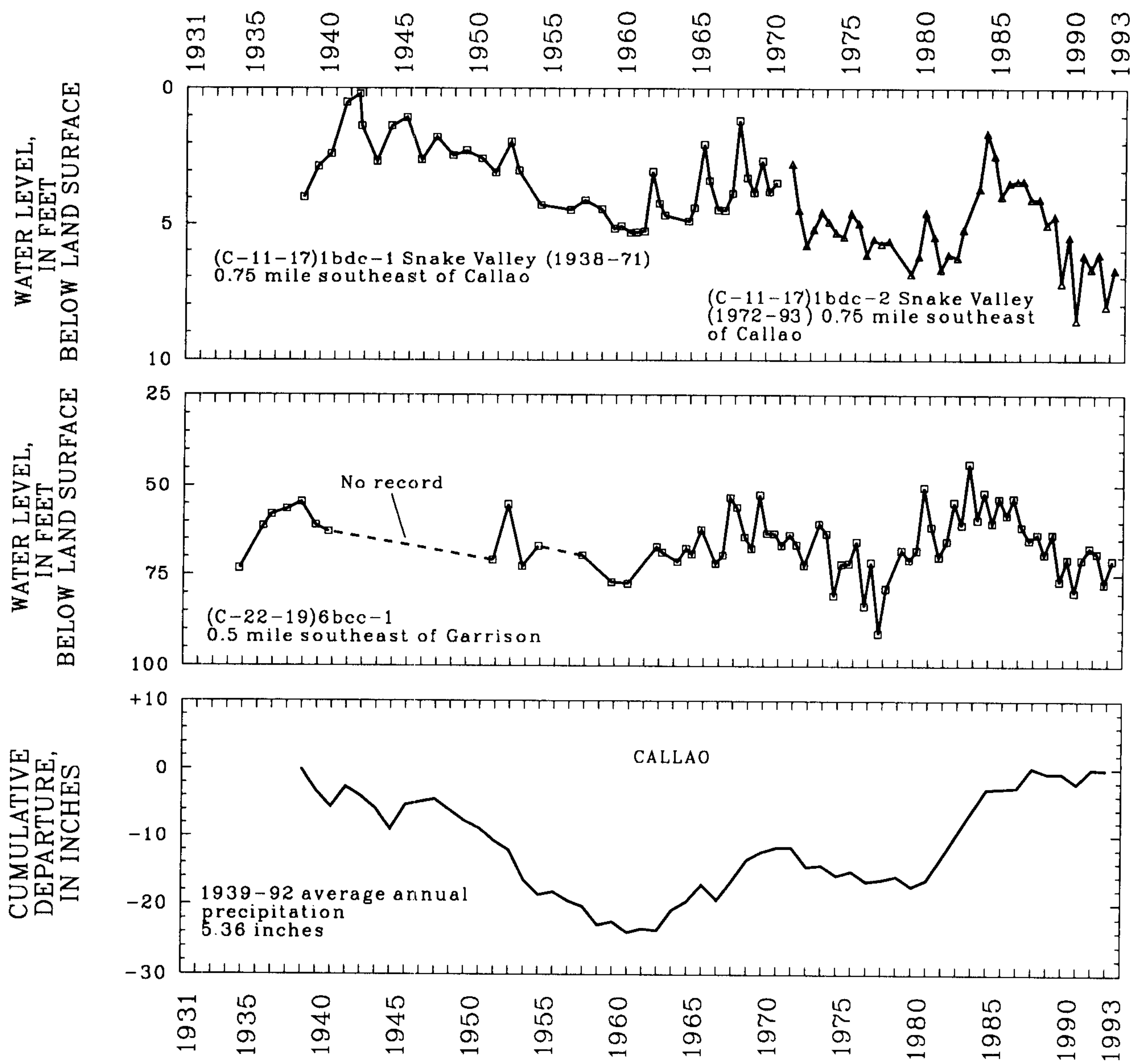

Figure 54. Relation of water levels in wells in selected areas of Utah to cumulative departure from the average annual precipitation at sites in or near those areas—Continued.

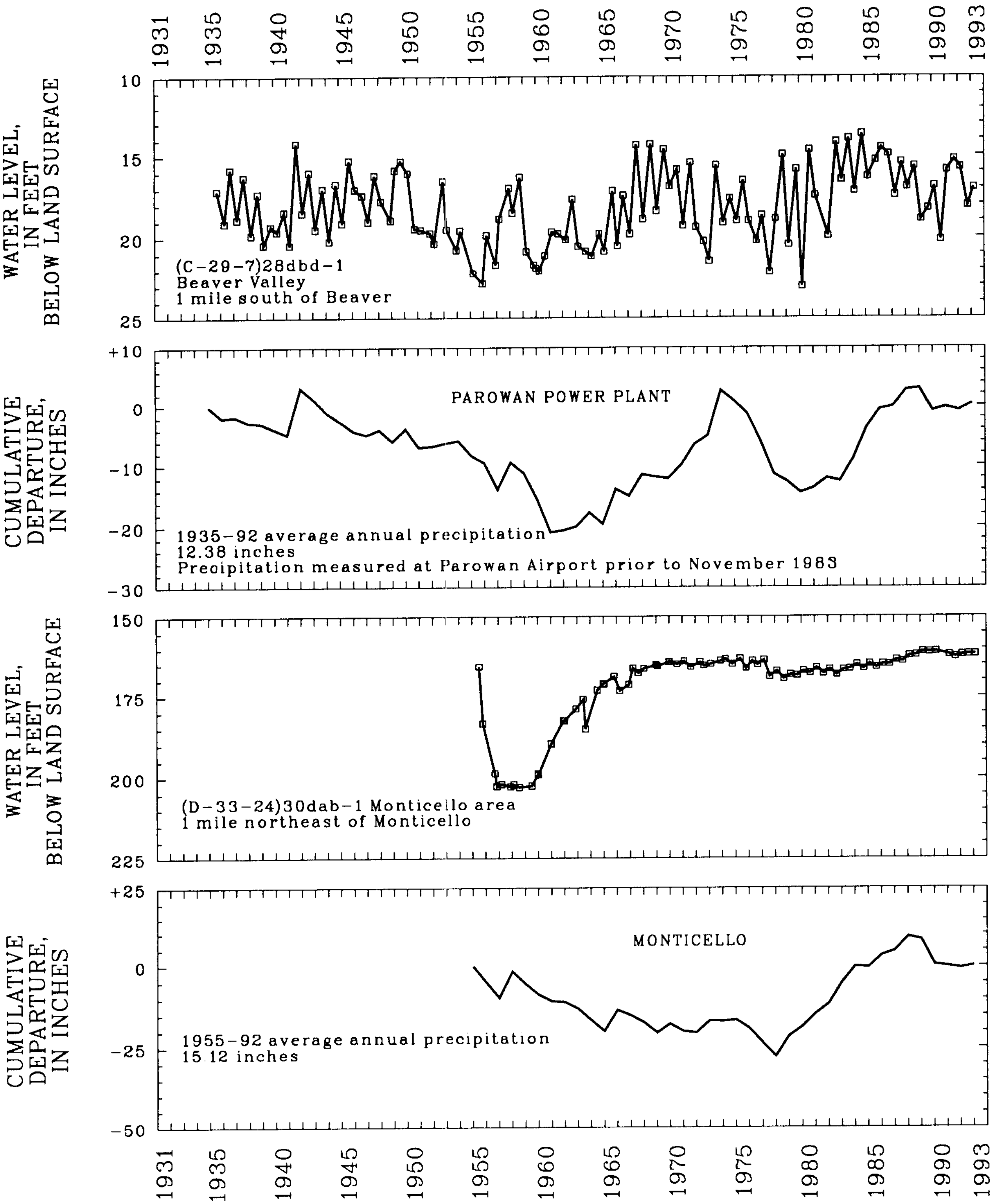

Figure 54. Relation of water levels in wells in selected areas of Utah to cumulative departure from the average annual precipitation at sites in or near those areas—Continued.

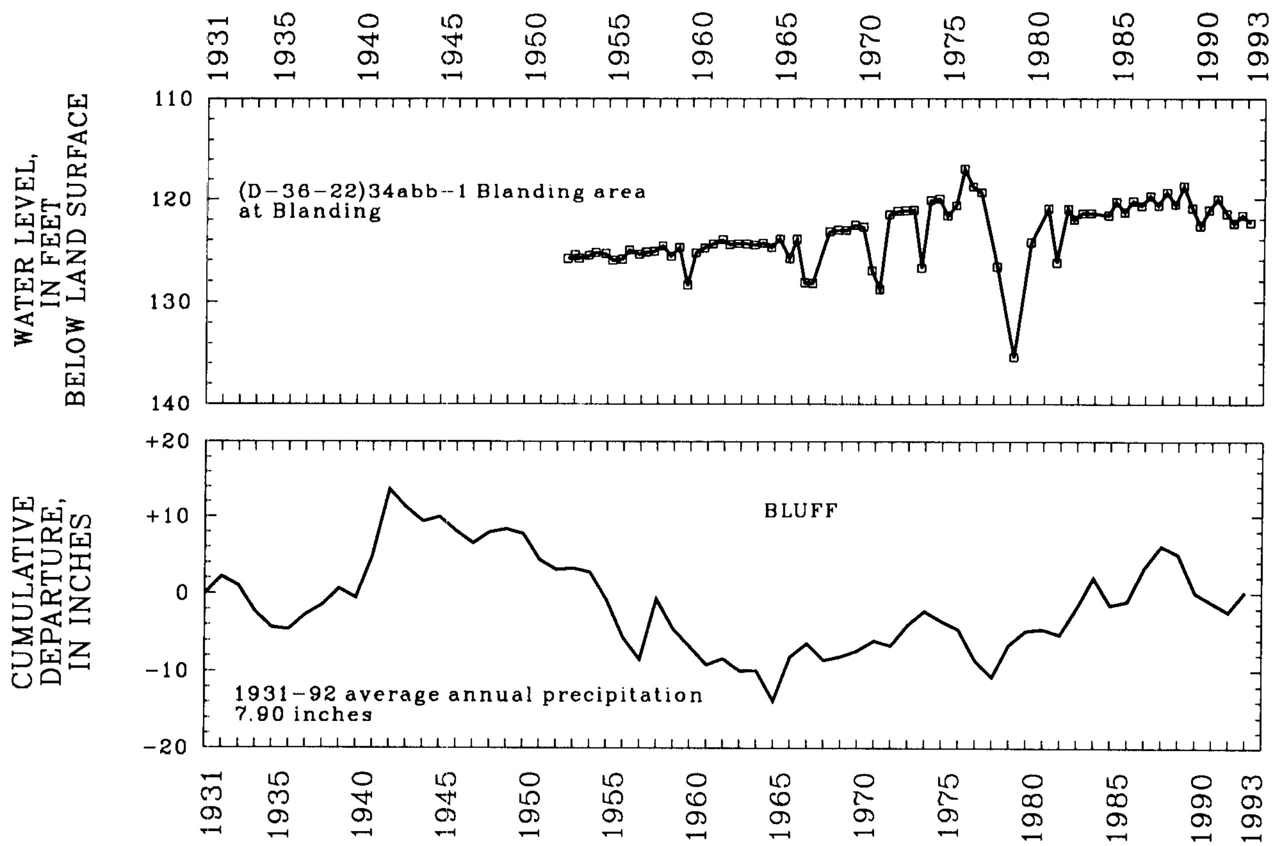

Figure 54. Relation of water levels in wells in selected areas of Utah to cumulative departure from the average annual precipitation at sites in or near those areas—Continued.

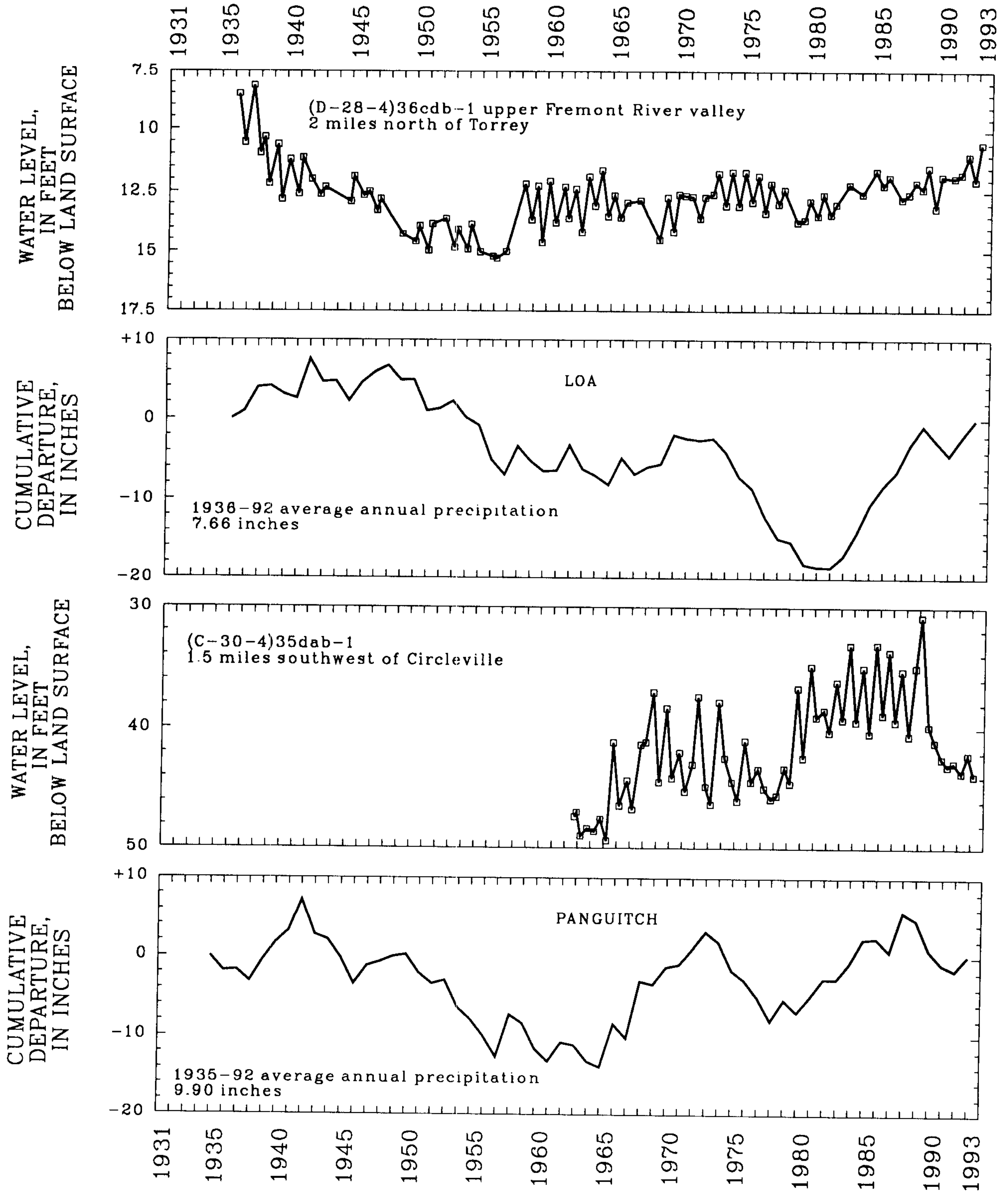

Figure 54. Relation of water levels in wells in selected areas of Utah to cumulative departure from the average annual precipitation at sites in or near those areas—Continued.

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